RC 970 G83 v.31 no.1
Biological & Medical Serials

No. 1 July, 1918. Vol. XXXI.

Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

ASSISTED BY

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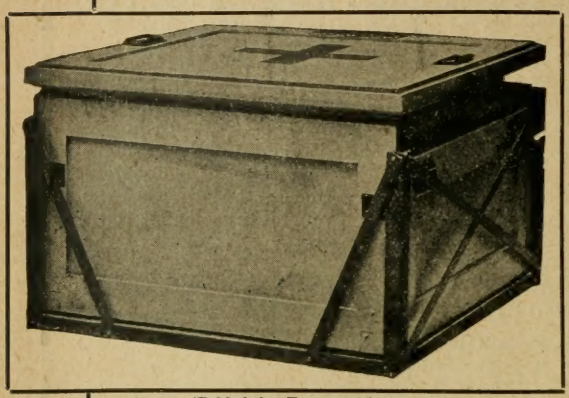

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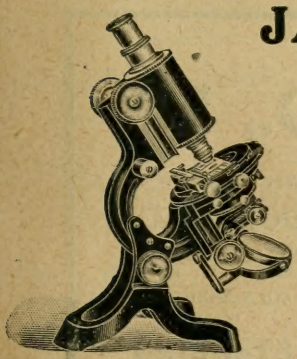

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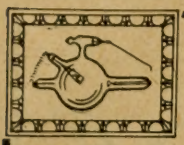

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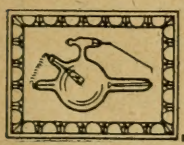

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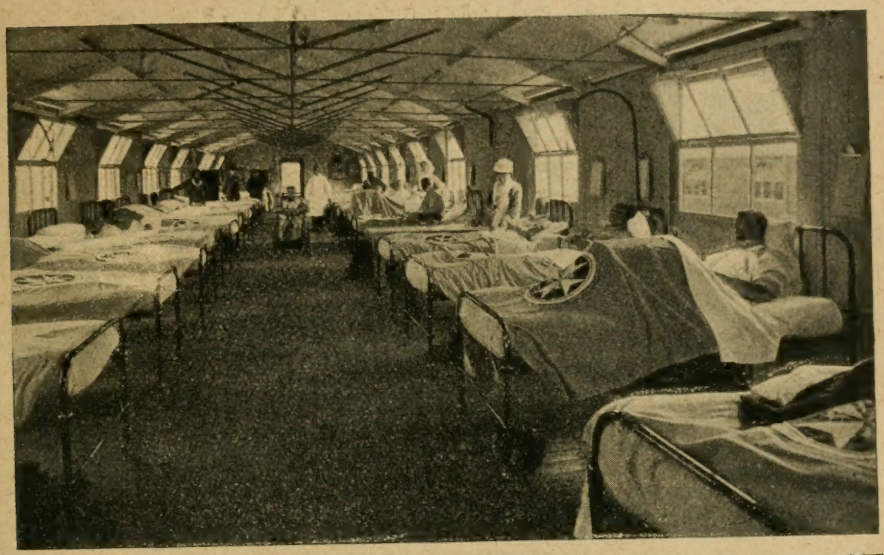

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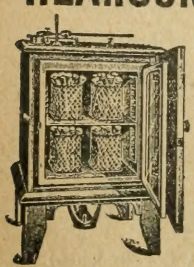

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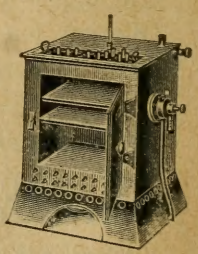

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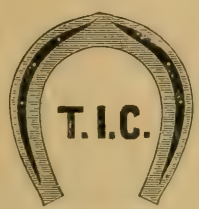

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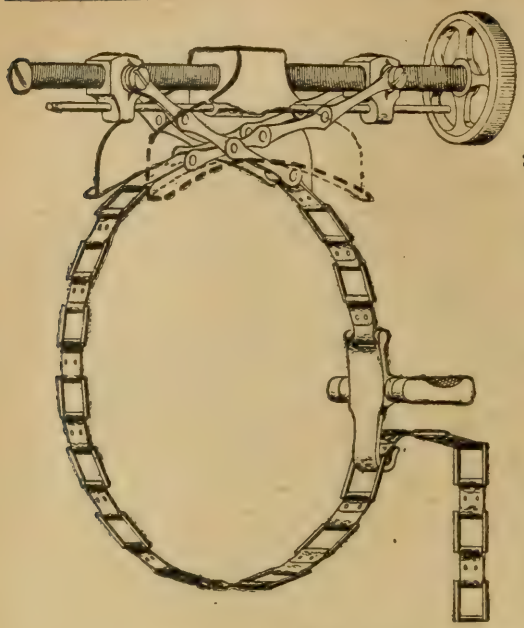

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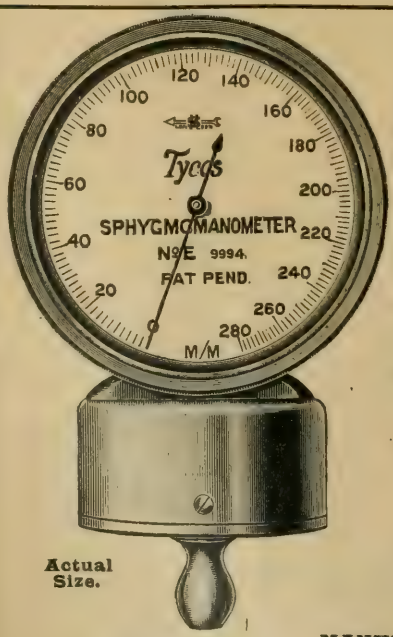

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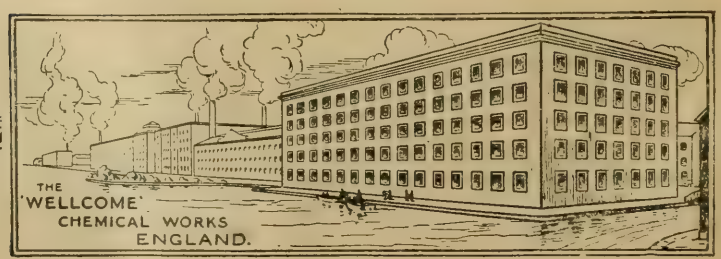

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VOLUME XXXI. JULY, 1918. No. 1.

Journal
of the
Royal Army Medical Corps.

Original Communications.

TOXIC ACTION OF CARBONIC AND OTHER WEAK ACIDS ON THE MENINGOCOCCUS.

BY J. A. SHAW-MACKENZIE, M.D.LOND.

IN attempting to discover an effective method of direct antiseptic treatment of cerebrospinal meningitis, it would seem advisable, when one considers the delicate nature and fundamental physiological importance of the nervous structures involved, to employ, as the basis of the antiseptic fluid in view, a solution as uninjurious as possible to mammalian living tissues. Ringer showed long ago that the tissues of cold-blooded animals are capable of long survival, if instead of perfusing or bathing them with 0·6 per cent NaCl solution, regarded up till then as the physiological solution *par. excellence*, a solution containing in addition to the sodium chloride, physiological amounts of calcium and potassium salts and a trace of sodium bicarbonate were employed. Many years afterwards Locke [1] succeeded in extending this line of work to mammalian tissues, and showed that a Ringer's solution of modified composition and containing in addition sufficient oxygen and a physiological percentage of glucose was capable of sustaining the activity of the excised mammalian heart for long periods. The power of conserving the vital activities of the mammalian tissues in contact with the Ringer-Locke fluid has since been abundantly confirmed by various workers in the case of many different organs. It has been pointed out, too, by Professor Halliburton [2] that the cerebrospinal fluid itself is in its composition to all intents and purposes nothing but a Ringer-Locke fluid of physiological origin. We have, therefore, abundant grounds for taking as the basis of any antiseptic solution with which it is proposed to treat the nervous system the Ringer-Locke fluid, in the hope that at any rate this will have no special deleterious effect of its own, and that we shall have only to fear such from the antiseptic agent we add to it. It

will be better too, if in all probability, instead of an antiseptic foreign to the body, we can find a physiological antiseptic agent, produced by an exaggeration or diminution of the physiological factors involved. From this general point of view the work described in the following has been undertaken.

I was led to this inquiry by my previous work on the toxic action of copper compounds of amino-acids and in particular copper-alanine on protozoa [3]. For, in the early part of last year, in some preliminary experiments, the opportunity for which was kindly afforded me by Professor R. T. Hewlett in the Bacteriological Laboratory, King's College, a toxic action of copper-alanine (one part in 100,000 of water) was found on the meningococcus also, on thirty minutes' exposure.

In further experiments carried out in association with Lieutenant-Colonel Mervyn Gordon and Major Hine, at the Central Cerebrospinal Laboratory, Royal Army Medical College, it was shown that the meningococcus did not survive in concentrations of copper-alanine 1 in 1,000 in sodium chloride solution, on twenty minutes' exposure, but in less concentration or in broth or serum, no toxic effect was observed in this time limit. Experiments were also made with the copper-alanine in Ringer-Locke solution. A somewhat more toxic effect was witnessed, as in this case the meningococcus did not survive in 1 in 10,000 copper-alanine on twenty minutes' exposure. No toxic effect was observed on five or ten minutes' exposure, and as for purposes of local treatment, intrathecal or naso-pharyngeal, a short time limit is obviously essential, the above results did not indicate any special advantage in the employment of copper-alanine as a bactericide in the treatment of cerebrospinal meningitis. Nor could the solutions of 1 in 10,000 in Ringer-Locke fluid be regarded as suitable for intrathecal use without fear of injury to the delicate tissues of the central nervous system.

In these experiments, however, it was noticed that in two out of three controls in 0·85 per cent sodium chloride solution alone, the meningococcus survived. On the other hand, the meningococcus had not survived in all three controls in Ringer-Locke solution alone. In all these cases the control solutions had been inoculated at the commencement of the series, and planted out in the usual way at the end—in each case the exposure having been forty-five minutes at 37° C.

This unexpected observation in the case of Ringer-Locke solution opened up therefore a further line of inquiry. For, if it held good that Locke's modification of Ringer's fluid, corresponding in its salt constituents to the natural fluids of the body, possessed in addition bactericidal properties towards meningococcus, obviously the value of this solution for irrigation purposes and intrathecal use would be still further evident.

Investigation has therefore been carried out by me in this direction in the Bacteriological Laboratory, King's College, with the assistance of Mr. F. Welch.

Technique.

The composition of the Ringer-Locke solution used was NaCl, 0·9 per cent; KCl, 0·042 per cent; $CaCl_2$ (anhydrous), 0·024 per cent; dextrose, 0·1 per cent; $NaHCO_3$, 0·02 per cent. The water employed was distilled in glass. The $NaHCO_3$ is added last to the remaining constituents after their previous sterilization. The $NaHCO_3$ itself cannot be heated to ensure sterilization, but in these experiments practically this has proved negligible. Five cubic centimetres of distilled water was added to a twenty-four-hour culture on trypagar slope of an isolated strain of meningococcus (Foster II) used throughout, forming a milky suspension (approximately 5,000 million meningococci to one cubic centimetre). Of this, in earlier experiments, 0·1 cubic centimetre was added to 10 cubic centimetres of the respective test solutions in sterile test tubes, and also to the same amounts of water, 0·85 to 0·9 per cent sodium chloride solution, and of trypsin broth; these latter were for control purposes; in subsequent experiments, in order to ensure greater uniformity in results, 0·2 cubic centimetre of the meningococcal suspension was taken as the inoculating dose. After five, twenty, and sixty minutes' exposure of the meningococcus in suspension to the various solutions kept at 37° C., the test tubes were well shaken and a three-millimetre loopful of each solution was planted out on trypagar slopes. These were then incubated at 37° C., and the results read off in twenty-four and forty-eight hours. The forty-eight hours' incubation is necessary as in many instances the twenty-four hours' incubation proved insufficient, and the result, therefore, at that period is unreliable. Either the subcultures of meningococcus showed growth or not, and the result was charted as + or —; even single colonies were marked +.

The Behaviour of the Meningococcus in Ringer-Locke Solution, and the Action of its Individual Constituents.

At first, using 0·1 cubic centimetre of meningococcal suspension as the inoculating dose, as previously employed, two out of three separate experiments showed that the meningococcus did not survive on sixty minutes' exposure to Ringer-Locke solution, thus appearing to confirm the original results. Controls in water and in 0·85 and 0·9 per cent sodium chloride solution survived. The action therefore of the individual constituents of Ringer and of Ringer-Locke solutions was investigated.

Water.—In water distilled in glass, as well as in ordinary distilled water and in tap water, the meningococcus was shown to survive on five, twenty, and sixty minutes' exposure.

Pure Sodium Chloride 0·85 and 0·9 per cent solutions. The survival of the meningococcus in these solutions has almost invariably been evident on five, twenty and sixty minutes' exposure at 37° C. and planting out, with incubation for twenty-four and forty-eight hours at 37° C. Since the

completion of my experiments my attention has been directed to the work of Flexner [4] and of Shearer [5], both of whom conclude that physiological solutions of sodium chloride have a destructive or toxic action on the meningococcus. The discrepancy between their and my results may be explained in part by the different conditions of experiment. In my experiments, I have confined myself to a short time limit of exposure, whereas Flexner's results apparently refer to comparatively long periods of exposure, and Shearer's to an exposure of seventy-five minutes. In a few experiments which I have since made, survival of the meningococcus has been evident on exposures for two hours, followed by forty-eight hours' incubation. Shearer notes, however, that freshly isolated meningococci are more vulnerable to the action of sodium chloride than old laboratory cultures; the former seldom resist the action of 0·85 per cent pure sodium chloride for more than twenty minutes, though the latter could sometimes resist the action for three to four hours. It may be that a difference in results is due to the salt itself employed. Throughout my experiments I was using "pure sodium chloride," but quite recently coming towards the end of this particular stock bottle, I started on another. The meningococcal controls in this sodium chloride solution did not survive as usual (and the results in several sets of experiments, in consequence, were discarded as valueless). The experiments had been carried out precisely in the same way as before except in the alteration of the salt employed. On reverting to the first stock bottle, the meningococcus again survived. Both specimens of the sodium chloride were Kahlbaum's "guaranteed pure for analysis."[1]

Calcium Chloride, Potassium Chloride, and Dextrose respectively in 0·85 and 0·9 per cent sodium chloride solution have each been favourable to the survival of the meningococcus in my experiments.

Sodium Bicarbonate.—Repeated experiments showed that the meningococcus did not survive on sixty minutes' exposure to sodium bicarbonate 0·02 to 0·04 per cent in sodium chloride solution. From this it was inferred that the injurious effects on the meningococcus in Ringer-Locke solution were due to the sodium bicarbonate. Repetition, however, of my previous experiments with Ringer-Locke solution, using 0·1 cubic centimetre of the suspension as the inoculating dose, failed to confirm the earlier results, and no difference was observed in the Ringer-Locke solution with or without the sodium bicarbonate. It is difficult to explain these contradictory results. It may, however, be mentioned that the Ringer-Locke solution employed in the earlier experiments was stock solution in

[1] Dr. Locke informs me that a similar variation in the behaviour of "chemically pure" sodium chloride from different sources in physiological solutions, was observed by him in conjunction with Dr. Rosenheim in 1903. Certain specimens give solutions which fail to keep the mammalian heart alive beyond two or three hours, and prevent it showing any improvement with dextrose.

which a commercial sodium chloride had been used which is no longer obtainable. It is possible this was of a toxic nature. It became of interest to ascertain the effect of increasing the percentage amount of sodium bicarbonate; but with one per cent and two per cent in Ringer-Locke solution, the meningococcus continued to survive. Not only this, but when sodium chloride solution was used, the addition of one per cent sodium bicarbonate exerted no greater effect than that of 0·02 per cent had done, while even in the two per cent solution the meningococcus survived. Repetition of the experiment on several occasions confirmed this, at first sight, paradoxical result. That increased percentages of $NaHCO_3$ had less toxic effect could hardly be explained on the supposition that it acted by virtue of its alkalinity or the relative concentration of the hydroxyl ions. Considering the well-known facts so important for the theory of respiration, of the dissociation of $NaHCO_3$ in solution into Na_2CO_3 and CO_2, it seemed not impossible that in dilute solutions with more complete dissociation of the salt, the free CO_2, especially in the case of micro-organisms, might be the active factor, and it became worth while to investigate the action in physiological solution of CO_2 and other weak acids on the meningococcus. In order to get rapidly a definite idea of the effect of weak acids, experiments were made first with acetic acid.

Action of Acids.

Acetic Acid.—After exposure of the meningococcus 0·2 cubic centimetre suspension to ten cubic centimetres solutions of acetic acid of strength respectively one per cent, 1 in 1,000, and 1 in 10,000 in 0·9 per cent sodium chloride solution, a toxic effect was definitely shown. The meningococcus survived only on five minutes' exposure in the 1 in 10,000 solution. Controls in sodium chloride solution and in water survived as usual on the sixty minutes' exposure. Further experiments were made with M/2500 acetic acid in 0·9 per cent sodium chloride solution (corresponding roughly to 1 in 50,000). Survival of the meningococcus was noted only on the five minutes' exposure; longer than this proved fatal.

Carbonic Acid.—Greater interest would seem to attach to the investigation of the effect of carbonic acid on the meningococcus. This is the weakest physiological acid. It is constantly present in greater or less amount in the blood and other body fluids. Its effects on living tissues when not pushed to their limit are reversible. A concentration too great to be borne by the central nervous system when perfused through its blood-vessels would probably be successfully resisted if the solution was introduced intrathecally, the persistence of the normal blood current in the central nervous system ensuring its survival.

Solutions of free carbonic acid were obtained by passing the washed gas from a Kipp apparatus through the fluid used, for periods varying from

one to two minutes, some approximation to saturation being thus obtained. In order, however, to obtain solutions containing known percentages of free carbonic acid, the method employed was one suggested to me by Dr. F. S. Locke which he had already made use of in order to prepare perfusion fluids for the mammalian heart, of known free CO_2 content. It possesses also the advantage of giving a solution that can be sterilized by boiling. The method depends on the conversion of sodium carbonate by sulphuric acid into sodium sulphate, sodium bicarbonate and (in accordance with the relative amounts of Na_2CO_3 and H_2SO_4) the percentage of CO_2 required. Thus:—

$$2\,Na_2CO_3 + H_2SO_4 = 2\,NaHCO_3 + Na_2SO_4$$
$$Na_2CO_3 + H_2SO_4 = CO_2 + Na_2SO_4 + H_2O$$

It is obvious, therefore, that by the mixture of suitable amounts of equivalent solutions of Na_2CO_3 and H_2SO_4 we can readily obtain within wide limits the required percentages of $NaHCO_3$ and CO_2. The Na_2SO_4 formed is for our purposes negligible. Ideal quantitative accuracy is not required in the use of this method, as the small percentage of $NaHCO_3$ always left in the final solutions acts as a "buffer" preventing the presence of free H_2SO_4.

It was found convenient to use $\frac{1}{4}$ normal solutions for the additions necessary for the formation of the small amount of $NaHCO_3$ used. For the further equal amounts of H_2SO_4 and of Na_2CO_3 forming the required percentage of CO_2, $\frac{1}{2}$ normal solutions were made use of. The following solutions were investigated:—

Solution No.	Ringer-Locke (without alkali or dextrose)	N/4H_2SO_4	N/4Na_2CO_3	N/2H_2SO_4	N/2Na_2CO_3	Volume per cent CO_2
	c.c.	c.c.	c.c.	c.c.	c.c.	
1	50	0·25	0·5	1	1	11
2	50	0·25	0·5	2	2	22
3	50	0·25	0·5	4	4	44

The necessary amounts of H_2SO_4 can be added to the non-alkaline Ringer-Locke fluid, and the mixture sterilized. The Na_2CO_3 solutions can be separately sterilized, and added in the cold to the H_2SO_4 mixture. Toxic effects on the meningococcus were found with Solutions 2 and 3, but not with Solution 1.

Similar solutions were investigated also in which fifty cubic centimetres sodium chloride solution were used in place of the Ringer-Locke solution. With these a toxic effect was found with Solution 1.

The results, together with toxic effects obtained at the same time with sterilized solutions of 0·9 per cent sodium chloride through which the CO_2 gas itself had been passed,[1] are given in the following tables of two experiments.

[1] (The supposed saturation with CO_2 thus obtained may be assumed to have been anything between sixty to eighty volumes per cent).

A third experiment was made with similar results: 0·2 cubic centimetre meningococcal suspension was taken as usual, as the inoculating dose to 10 cubic centimetres of each solution; results with Ringer-Locke solution (0·02 per cent $NaHCO_3$) and with $NaHCO_3$ (0·02 per cent) in sodium chloride solution, obtained at the same time and under the same conditions of experiment are given also, and in these 0·1 cubic centimetre suspension was taken as the inoculating dose as in the earlier experiments.

(1)	Forty-eight hours' incubation at 37° C.		
Exposure in minutes at 37° C.	5	20	60
Ringer-Locke solution CO_2 (Solution 1)	+	+	+
,, ,, ,, (Solution 2)	+	+	−
,, ,, ,, (Solution 3)	+	−	−
NaCl 0·9 per cent solution CO_2 (Solution 1)	+	−	−
CO_2 gas in 0·9 per cent NaCl solution	+	−	−
NaCl 0·9 per cent solution alone	+	+	+
Water (glass, distilled)	+	+	+
Broth	+	+	+
Meningococcal suspension at room temperature	+	+	+
Subculture +			

(2)	Forty-eight hours' incubation at 37° C.		
Exposure in minutes at 37° C.	5	20	60
Ringer-Locke solution CO_2 (Solution 2)	+	+	−
,, ,, (Solution 3)	−	−	−
NaCl 0·9 per cent solution CO_2 (Solution 1)	+	+	−
CO_2 gas in 0·9 per cent NaCl solution	+	−	−
Ringer-Locke solution (0·02 per cent $NaHCO_3$)	+	+	+
$NaHCO_3$ (0·02 per cent) in 0·9 per cent NaCl solution	+	+	−
NaCl 0·9 per cent solution alone	+	+	+
Water (glass, distilled)	+	+	+
Broth	+	+	+
Meningococcal suspension at room temperature	+	+	+
Subculture +			

It will be seen from the above that Ringer-Locke CO_2 solution, sodium chloride CO_2 solution, and sodium chloride solution, through which CO_2 gas has been passed, respectively, exert a definite toxic effect on the meningococcus. On the other hand, it will be seen that the meningococcus survived in Ringer-Locke solution (0·02 per cent $NaHCO_3$), but did not survive exposure of sixty minutes to $NaHCO_3$ (0·02 per cent) in sodium chloride solution. Controls in sodium chloride solution alone, water, and in broth, survived as usual.

Serum.—A destructive action by serum (guinea-pig) on meningococcus has been shown by Flexner. In the following preliminary experiment a rapid or increased toxic effect of serum through which CO_2 has been passed is shown. For this purpose fresh sterile serum (rabbit) was used. The serum was slightly blood-stained; 2·5 cubic centimetres of the serum so treated and 2·5 cubic centimetres of the normal serum were inoculated with 0·05 cubic centimetre of meningococcal suspension; the technique being otherwise the same as described in previous experiments. A toxic action

of the serum (rabbit) control is not evident under the conditions of a short time limit of exposure in my experiment. The effect of CO_2 gas in sodium chloride solution was again examined (0·2 cubic centimetre suspension to ten cubic centimetres solution), and the toxic action confirmed.

	Forty-eight hours' incubation at 37° C.				
Exposure in minutes at 37° C	5	..	20	..	60
Serum CO_2 gas	+	..	−	..	−
Serum alone	+	..	+	..	+
CO_2 gas in 0·9 per cent NaCl solution	+	..	−	..	−
NaCl 0·9 per cent solution alone	+	..	+	..	+
Water (glass, distilled)	+	..	+	..	+
Meningococcal suspension at room temperature	..	..	..	..	+
Subculture +					

Lactic Acid.—Next to carbonic the most important acid katabolite is lactic acid. It is produced by many organisms, and it seemed of interest to investigate its effect on the meningococcus which is known to ferment dextrose. Sarcolactic acid has not so far been investigated. The pharmacopœial lactic acid was made use of. In M 2500 and M/5000 (in 0·9 per cent sodium chloride solution) it was found to exert a marked toxic effect, showing survival of the meningococcus only on the five minutes' exposure.

On the suggestion of Dr. O. Rosenheim, an attempt has been made by me to investigate the relationship which might exist between the toxic effect of the above acid solutions and their hydrogen ion concentration. A hydrogen ion concentration of PH 7·02 represents absolute neutrality, and PH 7·35 near that of the blood [6]; which reaction for cultural purposes on nutrient media is also near the optimum for the growth of most pathogenic organisms [7]. The hydrogen ion concentration of cerebrospinal fluid (man) has been represented as PH 8·1 when fresh, but, on standing, it soon reaches PH 9·25, attributed to the loss of carbonic acid [8]. According to Hurwitz and Tranter [9] the PH varies from 8·15 to 8·3, and cerebrospinal fluid is thus regarded by them as more alkaline than blood. Milroy [10] has recently confirmed this, and points out further that the PH at low CO_2 pressure is higher, or, in other words, the alkalinity is greater than blood plasma.

For the above-mentioned purpose a series of Sörensen's standard mixtures of primary potassium phosphate and secondary sodium phosphate were prepared. It was found that in a mixture of 9·75 cubic centimetres M/15 primary phosphate and 0·25 cubic centimetre M 15 secondary phosphate, corresponding to a hydrogen ion concentration of PH 5·3, the meningococcus did not survive on sixty minutes' exposure. In primary phosphate solution alone, corresponding to a hydrogen ion concentration of PH 4·5, the meningococcus failed to survive on twenty minutes' exposure. I append a typical experiment, the technique employed being the same as before.

Phosphate mixture		Methyl red 5 drops, 10 c.c. colouration (before inoculation)	PH	Toxic action—minutes		
Primary c.c.	Secondary c.c.			5	20	60
3·0	7·0	Yellow ..	7·2	+	+	+
7·0	3·0	,, ..	6·4	+	+	+
9·75	0·25	Faint pink ..	5·3	+	+	−
10·0	0·0	Pink	4·5	+	−	−

The toxic lactic and acetic acid solutions gave similar reactions, the PH in these cases ranging also between 4·5 and 5·3. The toxic concentration of CO_2 in Ringer-Locke solution gave the same result. The much weaker concentration of CO_2 (11 vols. per cent) (Solution 1) however, which had been found toxic to the meningococcus in pure sodium chloride solution, gave only a yellow colouration with the indicator indistinguishable from that given by pure sodium chloride solution alone. In pure sodium chloride solution therefore a much weaker hydrogen ion concentration due to CO_2 is toxic to meningococcus than corresponds to PH 4·5 to 5·3. The indicators at my disposal did not permit of a more exact result than this. It is, moreover, obvious that the hydrogen ion concentration of the standard and other solutions is considerably lowered by the added meningococcal suspension which by itself possesses a distinct alkaline reaction. Further experiments in which the micro-organism itself is exposed directly to the solutions, or cultured in nutrient media of known PH, will be necessary to determine the point at which a toxic action is exerted. It will be necessary also to ascertain the hydrogen ion concentration of the cerebrospinal fluid itself in cerebrospinal meningitis.

In interpreting the results obtained with CO_2 regard must not be lost of the fact that CO_2 as an acid occupies quite a special physiological position as a general end product of vital chemical reactions. Increased percentages of it, therefore, in physiological fluids might exert a specific inhibitory effect on the vital activity of micro-organisms also, in addition to its effect as an acid in increasing hydrogen ion concentration.

It would appear from the results of the investigation described above, that local treatment of areas, intrathecal and naso-pharyngeal, infected with meningococcus might be tried with Ringer-Locke fluid, or with sodium chloride solutions, containing, as physiological antiseptics, physiologically excessive amounts of carbonic or lactic acids.

Slater [11], Rideal [12], and others have described the bactericidal action of CO_2 in solution on various pathogenic bacteria; these, however, differ considerably in their resistance to CO_2. The local application of the gas itself has also been described with sedative and beneficial effects in the treatment of open wounds and ulcerations, as well as by rectal introduction in cases of dysentery.

In extending this investigation I have found, in preliminary experi-

ments, that carbonic acid in sodium chloride solution exerts a rapid toxic effect on the protozoon opalina; also on *Spirochæta pallida*. The possible use of carbonic acid in syphilitic disease of the central nervous system, and in the treatment of diseases due to protozoa, is thus suggested.

In conclusion, I desire to express my best thanks to Professor Halliburton and to Professor Hewlett for the opportunity kindly afforded me in their laboratories, and for much kind assistance throughout this work. To Lieutenant-Colonel Gordon also my best thanks are due for his kind assistance throughout, and supply of the necessary cultures and nutrient media.

Conclusions.

(1) The meningococcus survives exposure to Ringer-Locke solution.

(2) Sodium bicarbonate (0·02 per cent and 1 per cent) in sodium chloride solution exerts a toxic effect on exposures of sixty minutes; a 2 per cent solution has no toxic effect.

(3) CO_2 and other acids in small concentration exert a toxic effect.

(4) In Ringer-Locke solution containing free CO_2 twenty-two vols. per cent and upwards, the meningococcus does not survive exposure of twenty minutes. In sodium chloride solution the toxic effect is more marked.

(5) The toxic action of serum through which CO_2 gas has been passed is pronounced.

(6) Lactic and acetic acid in M/5000 and M/2500 respectively (in 0·9 per cent sodium chloride solution) have a similar toxic action on the meningococcus.

(7) The preliminary experiments on the hydrogen ion concentration have not yielded sufficiently definite results to determine at what point the toxic action is exerted, and do not exclude a specific action of its own on the part of CO_2.[1]

(8) It is suggested that normal solutions containing increased amounts of CO_2 or lactic acid may, as physiological antiseptics, be employed in the local treatment of areas, intrathecal and naso-pharyngeal, infected with meningococci, and that even the CO_2 normally occurring in the plasma and body fluids may form part of the protective processes of the body.

(9) Preliminary experiments show that CO_2 in sodium chloride solution

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[1] Attention may here be drawn to the results of K. Taylor (*Lancet*, i, p. 294, 1917), which I only became acquainted with after my own work was completed. He has investigated the concentration of various acids inhibitory to bacterial growth. He does not mention CO_2, and regards his results as proving a specific action of acids without making any reference to hydrogen ion concentration. It is worth while, however, pointing out that if their correctness be assumed it is impossible to explain them in terms of the hydrogen ion. The ratio of the concentration toxic for one organism (even when recalculated molecularly, taking, e.g., acetic and propionic acids) is inverted in the case of another organism. This would nessitate the assumption of an inverse relation between molecular concentration and hydrogen ion concentration in either one or other of the two acids.

exerts a rapid toxic effect on the protozoon opalina ; and on *S. pallida*. It is not impossible that CO_2 might also be made use of in syphilis of the central nervous system, and in diseases due to protozoa.

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THE SYMPTOMS OF ACUTE CEREBELLAR INJURIES AS OBSERVED IN WARFARE.

By Lieutenant-Colonel GORDON HOLMES.
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(*Continued from page* 570.)

Disturbances of Speech.

Apart from the oculomotor, the only cranial nerves of which the functions are obviously affected by unilateral cerebellar lesions are those which are concerned in phonation and articulation.

Speech is abnormal in most cases in which the lesions are recent and severe ; it is usually slow, drawling and monotonous, but at the same time tends to be staccato and scanning. This gives it an almost typical "sing-song" character and makes it indistinct and often difficult to understand. In a few patients speech was in fact quite unintelligible for a time. In many cases the utterance is remarkably irregular and jerky, and that of many syllables, especially, as Marie has pointed out, of those that end a sentence, tends to be explosive.

Phonation is as a rule more affected than articulation, though both vowels and consonants are slurred and uttered unequally and irregularly. All classes of consonants too are affected, but articulation sometimes has a special nasal character and the labials particularly tend to be explosive.

Another striking feature is the apparent effort necessary to utter a series of syllables or a sentence ; the attempt is associated with excessive facial grimacing and speech has consequently a laboured character that often recalls a pseudo-bulbar paresis. A few of the patients also showed a tendency to burst into explosive and excessive laughter when amused.

These abnormal features subside as a rule rapidly, but in a few cases the speech was not yet natural two or three months after the infliction of the wound.

Reflexes

Striking alterations in the reflexes is not a prominent or very obvious symptom in the clinical examination of patients with cerebellar lesions, but they are frequently abnormal, or when the injury is unilateral they may be unequal on the two sides. The change can be best studied in the knee-jerks in cases in which the injuries are limited to one-half of the cerebellum, but they can also be seen in the arm- and in the ankle-jerks.

When the knee-jerks are elicited as the patient either lies in bed or sits with his legs hanging freely, that of the healthy side seems unaffected, but the homolateral jerk is at first often feebler, less brisk and less easy to elicit ; or a response may be obtained from one or two only of a series of

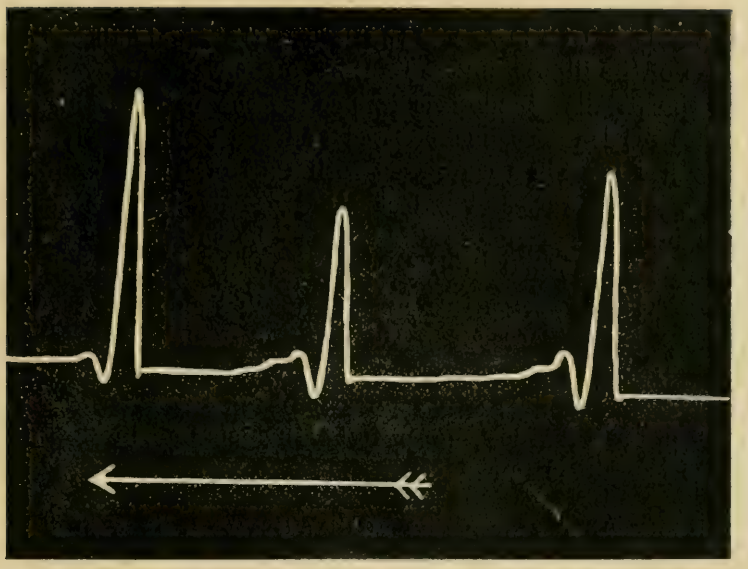

FIG. 11.—Tracings of three knee-jerks of a normal man taken on a slowly revolving drum. Read from right to left. The slight secondary swing seen in these tracings does not occur in many normal men.

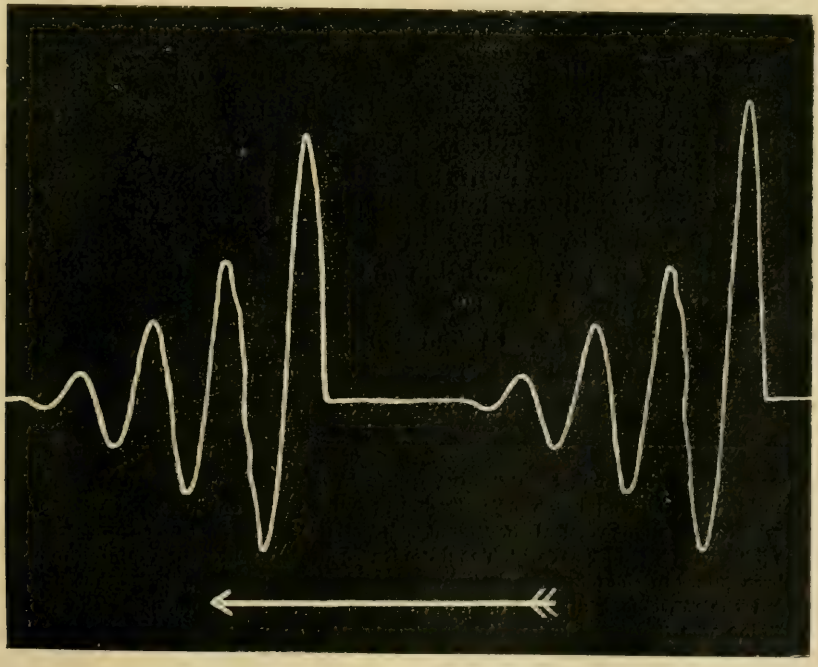

FIG. 12.—Tracings of two knee-jerks of a man with a right-sided cerebellar lesion of eight years' duration. Tracing is less reduced than that in fig. 11. Read from right to left.

taps on the patellar tendon, though the range of the jerk is then generally large and ample. In a few cases the jerks were wholly absent during the acute stages of the illness, unless reinforcement was employed.

When the patellar tendon is tapped as the patient sits on a high chair so that his legs are unsupported and can swing freely, the jerk of his homolateral leg when compared with that of his other limb appears less brisk, often slower, and it lacks that decisive, forcible character of the normal knee-jerk, though its range may be as large or even greater. Further, while the normal limb falls deliberately to its original position and quickly comes to rest, that of the affected side often continues to swing inertly to and fro for a time like a pendulum; the jerk has consequently the pendular character described by André-Thomas. This feature can be seen by comparing fig. 11 and fig. 12.

But in order to study more fully this change in the reflex it is necessary to record the movement of the leg on a more quickly moving drum.[1]

By this means I found that though from unaided observation the jerk was frequently described as slower or less brisk, there was no increase in the latent period as recorded by the apparatus I have employed. In several normal persons this, when measured from the instant the tendon was struck to the commencement of the movement of the leg, varied between 0·038 sec. and 0·054 sec., being in the majority 0·043 sec., which agrees approximately with the latent time obtained in man by Franz, by Guillain, Barré and Strohl and others by tambours placed on the quadriceps extensor. In the patients with cerebellar injuries in whom I have similarly recorded the jerk the latent period always lay within the same limits; in one man with a very severe lesion it constantly approached the lower figure. The apparent slowness is consequently not due to a delay in a response or to a slower movement of the limb; but it is probable the subjective interpretation of the inertness in the swing of the leg.

But such tracings (figs. 14 and 15) show other important changes. When that of a normal jerk is examined (fig. 13) it is obvious that the fall of the leg is considerably slower than its rise, and the curve

[1] My records were obtained by attaching firmly to the leg, at a fixed distance below the axis of rotation of the knee-joint, a properly shaped splint which carried a rod attached to it by a joint at which only slight vertical movement was possible. This rod was connected by a ball-and-socket joint with a longer bar which could move accurately and with a minimum of friction through three guides in the plane of the movement of the leg: a suitable marker fixed to this bar recorded the movement directly on a revolving drum. The moment of the tap on the patellar tendon was registered by an electro-magnet, the circuit being closed when the metal hammer, to which one terminal was connected, came in contact with a copper wire placed in close contact with the skin over the patellar tendon. Time was recorded by a tuning-fork of 128 vibrations per second (C°).

does not therefore correspond with the oscillations of a pendulum. Evidently then a tonic contraction, or state of tone, in the extensor muscles prevents the immediate fall of the normal leg to the abscissa. This fact is already known from the records obtained by various methods in experimental animals and in man. I have found the time

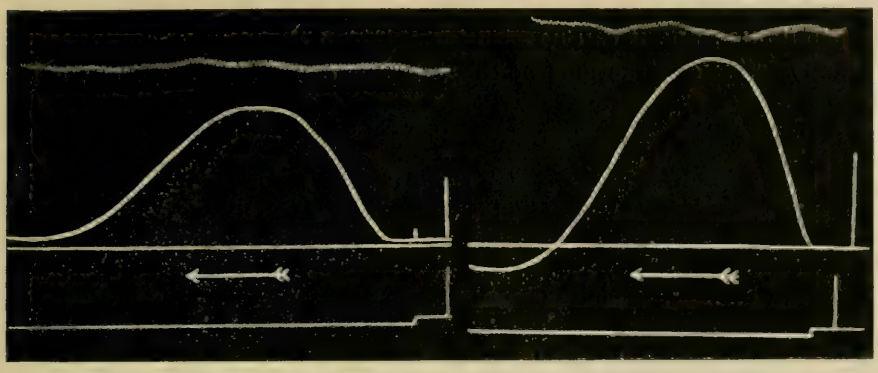

FIG. 13.—Tracings of the knee-jerks of two normal men recorded in a rapidly revolving drum. Read from right to left. Time by a tuning-fork of 128 vibrations per second. Reduced to one half.

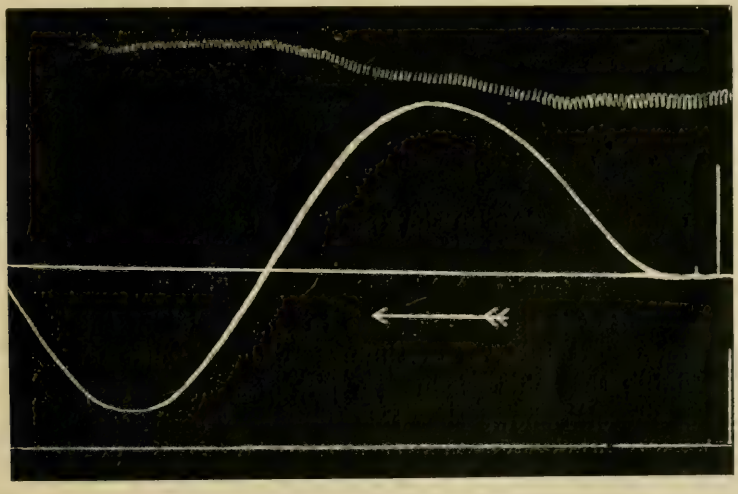

FIG. 14.—Tracing of the right knee-jerk of a man who received a severe injury to the right side of his cerebellum eight years previously. Read from right to left. Time by a tuning-fork of 128 vibrations per second. Signal on the lowest line.

of the rise in relation to that of the fall in several controls to vary between 1 to 1·2 and 1 to 2·2. In the curves obtained from the affected limb in men with cerebellar injuries the fall to the abscissa is on the other hand almost invariably more rapid than the rise (fig. 14) ; in the

cases in which I have measured it the relation of the duration of the rise to that of the fall of the curve averaged 1 to 0·85. Here there is consequently no evidence of tone or muscular contraction impeding or delaying the fall of the limb under the influence of gravity, and the falling limb acquires sufficient velocity to make it swing, provided its oscillations are not resisted by the tone of the muscles that move the knee-joint. These oscillations give regular curves which have all the features of those of a pendulum; and it can be easily ascertained that they are not associated with any active contractions of the extensor or flexor muscles of the knee.

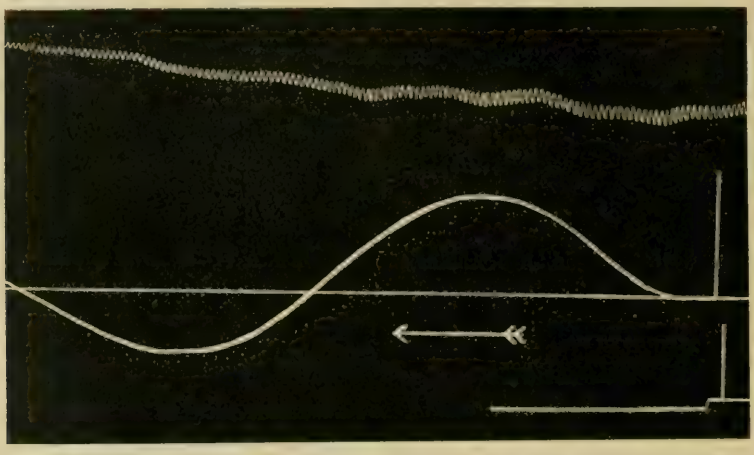

Fig. 15.—Tracing of the right knee-jerk of a man with an extensive injury of the right side of his cerebellum, obtained ten weeks after the infliction of the wound. Read from right to left. Time by a tuning-fork of 128 vibrations per second. Signal on the lowest line.

There is another feature in the knee-jerk of the affected side which can be easily detected by careful observation. If the observer places one hand across the hamstring tendons behind the normal knee he can generally feel a brisk tightening of these tendons, due to contraction of the flexors of the knee, at a very short interval of time after the patellar tendon has been struck, providing that this produces a jerk of sufficient range. Palpation of the flexor muscles shows that this tightening of the tendons is due to their active contraction, and not merely to passive stretching by the extension of the knee. On the affected side, however, no such contraction of the hamstrings can be felt, no matter in what position the knee is placed, or how great the amplitude of the jerk may be. One result of this may be seen if, while the two limbs are fully supported on the bed with the hips and knees semiflexed and the thighs rotated outwards so that the heels are at the same level, the patellar tendons are tapped in succession; the foot of the affected side is moved abruptly towards the bottom of the bed by each jerk that is elicited, but it returns, or tends to return, immediately to

its original position, while on the affected side the foot generally remains in the position into which it has been moved by the contraction of the quadriceps, and the knee can be in fact often fully extended by a series of taps on the patellar tendon. This failure of the contraction of the hamstrings and of the consequent pull back of the leg was present in all my cases of severe injury, and its occurrence was repeatedly confirmed by independent witnesses. It usually persists as long as there are obvious disturbances in the movements of the limb; it was very striking in a patient who had received his injury eight years previously.

The ankle-jerk is less commonly abnormal, though when the knee-jerk is depressed or difficult to elicit this reflex is usually more so. In five of my cases, however, in which there was no evidence of involvement of the pyramidal tracts, a short ankle-clonus could be obtained on the affected side; it resembled that due to organic disease but did not persist on continued pressure on the sole; in fact, as a rule it consisted of a few jerks only.

In many cases the flexor and extensor reflexes of the elbow were less brisk than on the normal side. In these reflexes it is less easy to detect a concomitant reflex contraction of the antagonists of the contracting muscles, but when the forearm is allowed to hang unsupported it frequently tends to swing in the pendular manner described by André-Thomas, especially after the triceps-jerk has been elicited.

No difference in the superficial reflexes, the abdominal, cremasteric and plantar, of the two sides could be detected in even the severest unilateral lesion, and in every case they presented their normal characters.

Sensation.

Finally we have to consider the state of sensation in cerebellar lesions. This is an interesting and important point, since Lussana regarded the cerebellum as an organ of the "muscular sense," and Lewandowsky has attributed many of the motor abnormalities to disturbance of muscle sensibility, meaning thereby those sensations evoked in consciousness by the state of contraction of the muscles, and by movement and the position in space of different portions of the body.

I have, however, examined every modality of sensation in many cases but have never found disturbance of any form, nor have I detected any evidence that would point unequivocally to any alteration of it. No matter how irregular the movements may be, or how far the affected limb deviates from the point to which it should be moved, the patient always has a full and accurate recognition of its position in space.

It is true that, as Luciani observed in animals, the withdrawal of a limb that is pricked and the reaction to the prick, are occasionally less brisk on the homolateral side when the lesion is early and extensive, but

no alteration in the threshold of, or diminution in the acuity to, tactile and painful stimuli, or even subjective differences between the sensations similarly evoked on the two sides, ever existed.

Lotmar has described a disturbance in the appreciation of weights by the affected hand, and Maas and Goldstein have supported his statements, but in none of their three cases was a lesion limited to the cerebellum demonstrated anatomically; there was for instance a diffuse cysticercus meningitis with hydrocephalus in Goldstein's patient. All three authors base their conclusions on the fact that when weights were simultaneously placed in his two hands the patient usually under-estimated that on the affected side. I have investigated the appreciation of weights in eleven cases with extensive unilateral lesions, and in some of them on several occasions. In two no disturbance existed, but in the others it was found that if while the arm was still asthenic identical weights were placed in his two hands, his eyes being closed, the patient frequently did not recognize that they were equal, and in almost every case stated that the heavier was in the affected hand. When unequal weights in which the difference was relatively small but appreciable, as 80 grm. and 100 grm. or 200 grm. and 240 grm., were placed in his hands, his replies were correct when the heavier lay on the affected palm, but often wrong when the normal limb carried it. Consequently the ability to recognize the identity or inequality of weights lifted simultaneously by the two hands was affected. In all these cases the tendency was to call that on the affected palm the heavier, except one man who at first occasionally described that borne by this hand as lighter, though in all subsequent examinations when the weights were equal or approximately so, that in the affected hand seemed to him the greater. But obviously these observations cannot be accepted as evidence of disturbance in the appreciation of weight, since by every paretic limb weights are adjudged heavier than they actually are, even though sensibility is unaffected. The greater effort which a patient suffering from a unilateral cerebellar lesion must put into all attempts to move the homolateral limbs suggest strongly that he will necessarily over-estimate, or estimate wrongly, the resistance which these movements encounter. Whether any disturbance in the appreciation of weights exists can be decided only by testing his ability to discriminate between two weights within the normal threshold of difference which are placed successively in this hand. This was done in all my eleven cases. The difference-threshold for the unaffected hand was first carefully ascertained and then a series of observations was made by placing the same two weights in succession in the affected hand. By this method no loss or defect in the appreciation of weights could be detected on either side; in one patient in fact the difference-threshold for the affected limb was considerably smaller than in the other and in several normal persons

who were tested at the same time, but this was explained by the fact that he had been a mica dealer in Canada and accustomed since childhood to "weigh" his wares in his left hand.

The following records, selected from a long series of observations which were obtained nineteen days after the infliction of the wound, in a man with an extensive lesion in the right half of his cerebellum, illustrate these facts.

Right hand	Left hand	Reply
200 grm.	200 grm.	Right heavier
200 ,,	200 ,,	,, ,,
200 ,,	200 ,,	Equal
200 ,,	200 ,,	Right heavier
200 ,,	200 ,,	,, ,,
200 ,,	200 ,,	,, ,,
200 ,,	150 ,,	,, ,,
150 ,,	200 ,,	,, ,,
150 ,,	200 ,,	Left heavier
200 ,,	150 ,,	Right heavier
200 ,,	150 ,,	,, ,,
150 ,,	200 ,,	Equal
150 ,,	200 ,,	Right heavier
200 ,,	150 ,,	,, ,,

But when the discrimination of weights was tested by placing two weights successively in the one hand he gave the following replies :—

First weight	Second weight	Right hand	Left hand
100 grm.	80 grm.	Correct	Correct
100 ,,	80 ,,	,,	,,
80 ,,	100 ,,	,,	,,
100 ,,	80 ,,	,,	,,
80 ,,	100 ,,	Equal	Equal
80 ,,	100 ,,	Correct	Correct
200 ,,	150 ,,	,,	,,
150 ,,	200 ,,	,,	,,
150 ,,	200 ,,	,,	,,
200 ,,	150 ,,	,,	,,
200 ,,	150 ,,	,,	,,
150 ,,	200 ,,	,,	,,

We must therefore conclude that no form of sensation is disturbed by cerebellar disease, and that though the patient often cannot compare correctly weights placed at the same time in his two hands, this does not depend directly on a disturbance of the faculty of appreciating and discriminating weights.

All the evidence available from the careful investigation of sensibility in cases of cerebellar lesions in man, in whom alone it can be properly tested, shows conclusively that this organ is not concerned in the trans-

mission, or in any modification or elaboration, of those afferent impulses which give rise to conscious sensations.

Symptoms due to Lesions of the Vermis.

I have not yet seen a case in which a gunshot wound produced a lesion limited to, or affecting mainly, the vermis of the cerebellum, though this was undoubtedly involved in some of the unilateral and in most of the bilateral injuries. Consequently the only conclusions on this point that can be drawn from my material must be by comparison of the symptoms in cases where one lateral lobe only was affected, with those present in which the vermis also was injured. But unless the differences in the symptoms of these two groups of cases are essentially distinct in one or more particulars they cannot be forthwith regarded as indicating a special physiological significance of the vermis, in view of the evidence of functional localization in the cerebellum which has been brought forward within recent years.

No essential difference can be detected when the symptoms due to lesions strictly limited to one lateral lobe are compared with those of cases in which the vermis is in addition involved, though in relation to the extent of the damage the functional disturbances are somewhat greater and recover less rapidly in the latter. The hypotonia, the abnormalities in the voluntary movements of the limbs, the changes in the reflexes and the nystagmus differ in no essential particular. Even the affection of gait and of equilibration, which has been attributed by certain authors (Thomas, Rothmann) to injury of the vermis, was not more pronounced when the lesion included this, provided it did not extend sufficiently beyond the middle line to produce symptoms in the opposite limbs. Two patients, for instance, were under observation at the same time—in one a piece of metal was removed from the lateral part of the left lateral lobe and considerable destruction of tissue was found around it, while in the second a large piece of shell-casing was extracted from deep in the mesial portion of the right lateral lobe, practically through the paramedian fissure, and a hernia which must have involved the vermis developed. The first man attempted to walk fifty-eight days, and the second seventy-one days, after the infliction of the injury and both succeeded equally well in walking and in maintaining equilibrium. Further, there was no striking difference in the characters of their gaits.

When the injury extends so far over the middle line as to produce also disturbances in the opposite limbs, gait and the maintenance of equilibrium are naturally more seriously affected than when one side only is involved.

The only special features of vermis affection that I have observed

are greater disturbances of phonation and articulation, and more pronounced tremor and greater difficulty in movement of the head and trunk when the patient sits up, but even in these respects the symptoms do not differ in nature from those produced by injury of both lateral lobes.

Symptoms of Bilateral Lesions of the Cerebellum.

In seven of my cases both sides of the cerebellum were injured; in four the missiles had passed transversely or obliquely through the organ, and in the other three there were tangential wounds which fractured and depressed the occipital bone over it. Four of these patients died; in one, who had a penetrating wound, the posterior margins of both hemispheres (lobi semilunares superior and inferior) were extensively damaged, but the vermis was injured only superficially in the region on the declivum; in two cases there were depressed fractures with extensive hæmorrhages and superficial softenings in each lateral lobe, but the vermis escaped, while in the fourth large portions of the vermis and both lateral lobes were destroyed by hæmorrhage.

All these cases presented the same symptoms, and no striking difference in nature could be detected between those in which the vermis was involved and those in which it escaped. The limbs of both sides were affected, but the disturbances of their movements differed in no essential particular from those that result from unilateral lesions. Speech was, however, very much disturbed; it was slow, drawling and scanning, and many syllables were uttered explosively. In two men it was so indistinct as to be scarcely intelligible. The muscles of the trunk and neck were very hypotonic, and the patients had difficulty in holding their heads in any attitude if it was unsupported, and in sitting up if unaided. The power of standing and walking could be observed in only one of these patients, and in this man gait particularly was more severely affected and the maintenance of equilibrium was more difficult, than in any case with a purely unilateral lesion.

Symptoms produced by Lesions of the Cerebellar Nuclei.

It is extremely difficult to determine the part played by damage of the nuclei in the symptomatology of these cerebellar lesions. Most penetrating gunshot wounds produce diffuse damage owing to the occurrence of hæmorrhage, œdema, softening and septic infection in the parts around them, and the nuclei, the dentate in particular, are consequently very liable to be involved even when the wound of the cerebellum is relatively superficial. On the other hand, when the nuclei are involved by such injuries a portion of the cortex is also destroyed. We can consequently decide which functional disturbances are associated with nuclear lesions only by comparing the symptoms of superficial with those of deep wounds.

In the first place we find that when the lesion is so superficial that the nuclei cannot have been directly injured the symptoms are less intense, less regular, and that they disappear much more rapidly. Several such cases could be cited, but two will suffice.

Case 1.—Captain J. was wounded by a fragment of shell and became immediately unconscious. When he was seen two days later a contused penetrating wound was discovered three centimetres below and 2½ centimetres to the left of the inion. An X-ray photograph revealed a piece of shell-casing, which had been driven through the skull, immediately under the wound. This and pieces of depressed bone were removed next day; a moderate area of destruction existed in the cerebellum, but it seemed to be superficial. By measurement it was found to correspond to the inner third of the lobus gracilis.

When he was first seen he presented all the symptoms of a severe cerebellar injury. He had difficulty in deviating his eyes to the left, and when he brought them over there was coarse, slow, regular and well-sustained nystagmus of large amplitude; on looking to his right the movements were smaller, more rapid, less regular and less well sustained. No nystagmus occurred on looking downwards, though intermittent but fairly regular jerks developed when his eyes were deviated upwards. His speech was slow, forced and scanning. His right limbs were unaffected, but the left were very hypotonic (all groups of muscles were equally so), slow in all movements though not appreciably weak, and their voluntary actions were disturbed by dysmetria, aimless deviations from the direct line of movement, dissociation into their component movements, and by the occurrence of tremor towards the end of the action. Adiadochokinesis and the rebound sign were marked in both arm and leg, and the left arm tended to swing outwards when outstretched, and deviated outwards in Bárány's pointing test. Yet twenty-four days after the infliction of the wound this patient was able to walk and use his limbs quite well, and did not complain of any abnormal symptom. On examination, however, it was found that some nystagmus still developed when he looked fully to the left, hypotonia was still demonstrable in the left arm, but this limb was now only slightly slow and awkward in attempting rapid alternate movements, and it still deviated outwards in the pointing test.

Case 2.—Private R. was wounded by a piece of shell-casing. He did not become unconscious, but in attempting to stand up staggered like a drunken man and fell to the left. When he arrived in a base hospital two days later a gutter wound was found extending from the middle line two centimetres below the inion towards the tip of the left mastoid. An X-ray examination showed fracturing with depression of bone fragments to a depth of 1½ centimetres under the inner portion of the wound. (This corresponded to the inner part of the lobus semilunaris inferior and the upper margin of the lobus gracilis.) These fragments were removed from the cerebellum and the wound was cleaned and drained.

When he entered hospital he had slow, coarse, sustained nystagmus in looking to his left, fine and more rapid movements on deviation to the right, and hypotonia, slight paresis and considerable ataxia of his left limbs. Twelve days later, however, he could use his limbs quite well, walk safely and on examination he presented practically no abnormal symptoms.

Such cases, in which the lesions were in all probability superficial, suggest strongly that the ordinary symptoms of a destructive injury are usually transient and recover rapidly if the deeper parts of the cerebellum, and especially the nuclei, are not directly or indirectly involved. Certainly such rapid improvement is never seen when the damage extends to the neighbourhood of the central nuclei.

On the other hand, these superficial lesions produce all the symptoms that are found when the nuclei too are injured, and they differ from these only in degree.

Consequently, as far as my present observations permit, it must be concluded that the effects of nuclear and of cortical lesions of the cerebellum differ in no essential particular, though those produced by the latter are less intense, less regular, and recover more rapidly.

These statements can refer to the nucleus dentatus only, as I have seen no case which survived long enough to permit thorough examination in which there was reason to believe that the roof nuclei were involved. If a wound extends so deep, it is very liable to open the fourth ventricle and lead to an early fatal termination. The dentate nucleus, however, is only two or three centimetres deep from the posterior surface of the cerebellum, which is the site of most gunshot injuries.

The Nature of the Symptoms produced by Cerebellar Lesions.

A study of the symptoms of destructive lesions and a determination of their constancy and relative importance will form a sufficient basis for the clinical diagnosis of diseases of the cerebellum, but in order to obtain an insight into the normal functions and the physiological properties of this organ it is necessary to analyse and attempt to resolve these numerous functional disturbances into their simplest components.

This is unquestionably a difficult task; in the past it has been the subject of much discussion and controversy among physiologists, who can deal with simpler factors and possess means of measurements that are not available to the clinician; the clinician, however, has the advantage that he can rely on the intelligent co-operation of his patients and consequently employ more numerous and better adapted methods for observing the effect of various lesions. Certain problems indeed, as the occurrence of sensory disturbances, can be decided only by clinical observations.

The first point which demands attention is the nature of the symptoms already described. Are they to be attributed to destructive or to irritative lesions of the cerebellum? Their constancy, their regularity, their persistence for long periods, and especially their nature, suggest strongly that they are directly due to destruction and that they are consequently negative or defect phenomena. In the case of many of them, as the

muscular atonia, this cannot be doubted, and indeed careful observation makes it probable that irritative effects are minimal after gunshot injuries of the cerebellum in man. Those forced movements and attitudes which Luciani has tentatively termed "dynamic phenomena," that occur so commonly after experimental injuries in animals, are very rarely seen in man, or occur at least only as immediate symptoms. Vertigo, if it is to be included among the true cerebellar symptoms, is more probably of irritative origin; its inconstancy, its variability, and the facts that it occurs only early after the infliction of the injury and is rarer in gunshot wounds than in cases of tumour or abscess, favour this view. It may be consequently safely assumed that the functional disturbances with which we have to deal are produced only by negative or destructive lesions of the cerebellum.

It is worthy of note that, as von Monakow has pointed out, symptoms referable to the effects of shock or diaschisis on other parts of the nervous system are rarely obvious.

Atonia, or diminution of that slight constant tension which is characteristic of healthy muscle, is such a constant and striking feature of all early injuries, and persists for such long periods when the wounds are large, that it is obviously a primary and direct symptom.

The state of the tendon-jerks has been generally taken by clinicians as a measure of tone, and yet it is the rule that even in the toneless limb of a cerebellar patient the knee-jerks and similar reflexes are not abolished, and the excursion of the jerks may be even larger than on the normal side. Physiologists too (Risien Russell, André-Thomas) have found the homolateral reflexes exaggerated after unilateral experimental ablation. But tone is dependent not only on the activity of the direct spinal reflex arc, the integrity of which is essential for the presence of the knee-jerk, but on other factors too, as on labyrinthine and cerebellar influences; or rather that state we call tone is influenced by several factors and the presence of the knee-jerk indicates only the activity of one, that is of the spinal reflex arc. Consequently the presence of the knee-jerk is not an argument against the existence of atonia in cerebellar disease.

But even when septic infection and the effects of increased cerebrospinal pressure can be excluded the knee-jerk and the other tendon reflexes are in some cases depressed, or they may be even for a time absent, on the side of an early and extensive lesion. As far as clinical observations go this seems to be generally associated with an extreme atonicity of the muscles, but their relation is probably not direct. The depression of the reflexes may be due to transient shock or diaschisis as it is an early hemiplegia; or it is perhaps owing to the fact that the muscles are so atonic that a tap on the tendon does not produce a sufficient increment of tension in them to be an adequate stimulus. The common observation

that a reflex response can be frequently elicited by only one of a series of taps, or when the knee is in a certain position, and that it is then quite brisk, favours the latter hypothesis.

Recent physiological investigations (Sherrington, Langelaan) have shown that tone is a more complex condition than has been generally realized by clinicians; it may indeed be a compound state, its separate components being perhaps dependent on distinct elements of the muscle fibres, and possibly on separate innervation.

If these views prove correct it will be the task of experimental physiology to determine what component of tone is affected by cerebellar injuries. The study of the knee-jerk by the graphic method shows that the tonic contraction of the quadriceps, which prevents the free and immediate fall of the extended leg under the influence of gravity, is absent or diminished when the homolateral side of the cerebellum is injured; the jerk has then the character of that described by Sherrington when the reflex excitability of postural contraction is low, or when what Langelaan calls plastic tone, that is the slow yielding of the extensor muscles to a continued stress, is absent or diminished.

Langelaan has indeed already suggested that decerebrate rigidity is partly due to a spasm of the muscle sarcoplasm of sympathetic origin owing to the prevailing influence of the cerebellum, but Horsley and Clarke found that decerebrate rigidity persists after destruction of the cerebellum, unless the paracerebellar nuclei too are injured, and Sherrington also states that the cerebellum can be removed without the posture in this condition being annulled.

It appears obvious however that the various symptoms of atonia described above can be attributed to this loss or diminution of postural contraction or plastic tone; its absence abolishes the normal resistance of the various segments of the limbs to passive movement, leaves the muscles less elastic to sudden stretching, and makes them soft and flabby to palpation.

Clinical experience, therefore, fully confirms the statements of Luciani and other physiologists that atonia is a constant, important and striking result of acute cerebellar destruction. It diminishes gradually in time, and may, like all the other symptoms, disappear, at least if the lesion is not very extensive. I have, however, at present no definite observations on this point, nor will it be possible to obtain satisfactory conclusions until we possess a reliable clinical method of measuring tone.

The remarkable fact that atonia as a symptom of cerebellar disease has received little attention from clinicians is probably due to its gradual decrease after the onset of acute lesions, and to its compensation *pari passu* with the progress of degenerative and atrophic diseases. Babinski, for instance, states that even in particularly severe cerebellar affections

he has found no atonia, and André-Thomas in 1911 wrote that he had never observed muscular relaxation or hypotonia, in the sense which is given to it by clinicians, in any patients he had examined.

The latter author, however, in 1914, elaborated in conjunction with Durupt an hypothesis, foreshadowed by Rothmann, according to which focal lesions of the cerebellar cortex produce a condition of anisosthenia, or hyposthenia of certain muscles and hypersthenia of their antagonists. Of this condition I could find no evidence either when only local circumscribed lesions existed, or as the symptoms of more extensive injuries cleared up.

The next group of symptoms that claims our attention are those seen in voluntary movement. Certain of them are most easily studied in simple actions against resistance. It has been shown that when a man with a cerebellar lesion attempts to grasp the observer's two hands simultaneously: (1) the power exerted by the affected limb is defective; (2) the initiation and the execution of muscular contractions and relaxations are slower than on the normal side; (3) the grasp is often intermittent and irregularly maintained; and (4) the affected limb tires more quickly than its fellow. These symptoms can be equally well demonstrated in other actions.

Asthenia.—This term, which Luciani has applied to the diminished functional energy of the affected limb, may be conveniently used to describe their lack of normal power in movements that demand its exertion. It differs so definitely from the paralysis and paresis produced by disease of the motor system that it is advisable to designate it by a distinct word.

That any degree of feebleness is ever produced by cerebellar lesions has been denied by many, and others who have observed it have attributed it to pressure on the motor tracts (Rothmann), to co-existing cerebral foci, to atonia, or to ataxia (Mann). In the early stages of every severe injury it is, however, easily determined that the homolateral limbs are feebler than their fellows, and when their strength is measured a very considerable reduction of power may be found in all groups of muscles, though it is usually more obvious in the arm than in the lower extremity. The greater effort necessary to deviate the eyes fully towards the side of the lesion, and the frequent defect in the range of their movement in this direction, is another manifestation of this asthenia. It has been already emphasized that the asthenia is not due in any large part to ataxia or awkwardness of the limb and a consequent misdirection of its energy; and though it is usually most definite when the limbs are very hypotonic it cannot be attributed to loss of tone, as these two symptoms bear no relation to one another. Asthenia must be consequently regarded as another primary and immediate symptom of cerebellar injury. It is probably pronounced only when the cerebellar nuclei are

involved. The abnormal fatiguability of the affected limbs is associated with, and may be regarded as a result of, this asthenia.

Slowness in movement has been noticed by both clinical and experimental observers. It is certainly not willed or intentional as André-Thomas states, nor can the delay be attributed to time lost in "taking up slack" in the atonic muscles, since the latency of toneless muscle is very short (Sherrington), and this explanation would not account for the closely associated delay in relaxation. And since it occurs in the simplest actions, as in simple flexion of the fingers or elbow, it is obviously not dependent on the inco-ordinate and inappropriate muscular associations which disturb voluntary movements. Finally there is no evidence that a contraction or state of increased tone of the antagonists delays or impedes the shortening of the contracting muscles.

In order to understand its nature it is necessary to study simple actions, and if possible by the aid of the graphic method. It is then seen that it is due both to delay in starting the contraction and to slowness in completing it. Further careful examination shows that there is usually associated with it a similar delay in commencing and completing the relaxation of the same muscles, which is occasionally even more pronounced. This slowness may be due to retardation of the impulses that excite voluntary muscular contractions; or to the fact that certain nervous mechanisms concerned in the production of voluntary movement react too slowly to these cerebral impulses; or it may be dependent on a state of the muscles owing to which their contractions and relaxations are retarded. As there is no evidence or probability that the cortical motor centres from which these impulses come are in any way affected the first of the hypotheses may be excluded. And as there is not a corresponding delay in the contractions and relaxations of muscles that are excited electrically or reflexly there is not sufficient basis for the third possibility. It consequently seems that the cerebellum exerts an influence on the nervous mechanisms, most probably on the spinal, immediately concerned in the execution of voluntary muscular contractions, by virtue of which these react promptly to cerebral impressions.

The cerebellum might be therefore regarded as a motor reinforcing organ, in the sense in which Luciani and others have used this term. It seems, however, probable that it takes no direct part in the processes, whether initiated reflexly or voluntarily, that produce motor effects, and that it does not augment these, but that it "sets" or "tunes," or regulates the activity of certain motor mechanisms, most probably spinal, so that the response to a volitional stimulus is immediate, effective and proportional to the intensity of the cerebral impulse.

Closely associated with asthenia is the discontinuity and irregularity in the maintenance of muscular contractions. This disturbance can be

observed in almost all voluntary movements and in the contractions of muscles concerned in maintaining posture (static tremor), but it is most easily studied in actions that demand the exertion of power; in these the contractions reach their maximum slowly and intermittently, and while in the normal limb a forcible contraction can be maintained regularly for some time, the grasp or other action which the patient attempts with the affected limb is often discontinuous and irregular, and it is frequently interrupted by sudden relaxations. The outstretched arm if unsupported often, for instance, falls suddenly, and in walking the affected leg frequently gives way under the patient without any apparent cause. The tremor that occurs in maintaining an attitude and in voluntary movements is due to this defect in the regularity and stability of the muscular contractions. Luciani has described this condition as *astasia*, and has attributed it to the imperfect fusion and summation of the single twitch contractions. Patrizi has indeed shown experimentally that cerebellar lesions lead to an incomplete fusion of the elementary twitches in muscles.

Astasia is not, however, such a prominent symptom in most local lesions of the cerebellum in man as it is in animals after experimental destruction, though it varies in degree in different cases. It does not seem to stand in any close relation to the atonia and it is probably not in any way dependent upon it; it is, on the other hand, intimately associated with asthenia. Consequently, in addition to that function by virtue of which it assures that the motor response to a voluntary cerebral impulse shall be immediate and proportional to the impulse, the cerebellum also exerts an influence on the efficiency of this response by determining the complete fusion of the elementary muscle twitches.

Clinical observations consequently confirm Luciani's conclusions that atonia, asthenia and astasia, the triad of symptoms to which he attributes all the functional disturbances, result from cerebellar lesions.

But there are other symptoms that cannot be explained by these factors only. Among them is the *rebound phenomenon* which throws considerable light on the nature of the motor disturbances. The excessive range of the after-movement may be due to absence or to long delay of the voluntary contraction of the antagonistic muscles; the fact that the patient's hand can be flung forcibly into his face shows indeed that prompt voluntary arrest is not possible, but it must be ascribed mainly to failure of the immediate reflex contraction of these antagonists when they are suddenly stretched. The absence of contraction of the hamstrings when the knee-jerk is elicited under certain conditions is a similar phenomenon; the muscles do not react normally to a sudden putting on stretch. It is true that the same may be observed in other conditions associated with loss of tone, as in peripheral nerve lesions and in tabes dorsalis, but the fact that the tendon-jerks, which must be regarded as reflexes of the same nature,

are not as a rule lost and may be exaggerated in cases of cerebellar injury shows that the atonia associated with this condition does not affect this form of reflex function. Both the biceps and triceps reflexes are in fact quite brisk in cases in which the rebound phenomenon can be demonstrated in extension and flexion of the forearm. It may be consequently assumed that the rebound phenomenon is not directly due to loss of muscle tone, but to failure of the muscles to contract promptly and efficiently when they are suddenly put on stretch. It is a manifestation of the loss of what Rothmann has called the antagonist's reflex.

On analysing the complex condition often called *cerebellar ataxia*, we meet with other facts that cannot be explained by atonia, asthenia and astasia alone. The kinetic tremor is, it is true, chiefly a manifestation of astasia, but the disturbances termed asynergia, decomposition of movement, and deviation from the line of movement, must be considered more fully.

The term asynergia here implies a defect in that accurate functional combination of the muscles which participate in a movement, that is the agonists, antagonists, synergic and fixating muscles, on which the precision and correct adaptation of the movement to its end depends. We have seen that on closing the fingers the wrist is often hyper-extended, or it extends too little or too late, and when the fingers are rapidly flexed and extended the appropriate wrist movements do not occur simultaneously. Here the co-operation of the agonists and their synergics is obviously disturbed.

Again, when the patient attempts to bring each finger in succession to the tip of his thumb all or several of his fingers flex simultaneously, and much the same may be seen when he handles a small object; this is due to the agonists and antagonists not working properly together as they must to permit the flexion of an isolated finger. Similarly, in rapid alternate movements one or other excursion is often abruptly arrested owing to disturbance in the reciprocal relations of agonists and antagonists.

And as the patient attempts to pronate and supinate his forearm quickly, various irregular and inappropriate movements occur at the shoulder, elbow and even at the wrist, owing partly at least to defective fixation at these joints.

Finally, when for example he flexes and extends his ankle alternately, the knee and hip often flex and extend simultaneously, owing, not to defective fixation but, as may be easily determined by palpation, to active contractions of the thigh and pelvic muscles. Here the intervention of muscles that should not be concerned in the action disturb its precision.

Other instances can be easily cited of all these forms of disturbance.

This affection of the normal harmony and correct co-operation in time and degree of the various muscular contractions concerned in movements and in the maintenance of posture is such an important factor in cerebellar symptoms that it claims careful attention. It is essentially an

inco-ordination or ataxia (i.e., absence of discipline or arrangement) of the active muscles, though these terms have become so vague and have given rise to so much confusion that they must be reluctantly employed. Parenthetically it may be pointed out that ataxia, when employed in its literal sense, is more correctly applicable to these disturbances than to that component of the irregularity of movement seen in tabes dorsalis, which depends upon or is influenced by loss of the sense of position, and which is consequently most pronounced when the movements of the limbs are not controlled by vision.

A disturbance in the co-ordination of the muscles engaged in individual movements must be therefore accepted as a symptom of cerebellar disease, and its acceptation does not involve the "creation of an abstract and fictitious entity, the principle of co-ordination." All actions are the product of the activity of several and subcortical centres, and though it is the cortex which initiates voluntary movement and probably selects and integrates the adequate impulses for individual acts, the elaboration and co-ordination of the numerous factors that are concerned in each must depend largely on subcortical centres. We have learned from Sherrington's work the elaborate integration of which even the isolated spinal cord is capable in reflex acts. His experiments have demonstrated that it is on the afferent impressions of the proprioceptive system that the control and regulation of the spinal reflexes chiefly depend, and numerous experiments and clinical observations have shown that this system exerts similar functions in voluntary movements. Professor Sherrington has happily described the cerebellum as "the head ganglion of the proprioceptive system," and if this view, which conforms to the anatomical connexions of this organ, is accepted it would be natural that one of its chief functions should be the exertion of a regulating and co-ordinating influence in more complex movements.

Babinski has applied the term asynergia particularly to the inability to perform simultaneously the various movements that constitute an act, and we have seen that this condition, which has been referred to here as decomposition of movement, does occur, especially in recently wounded patients. André-Thomas and Durupt attribute it partly to voluntary dissociation and partly to dysmetria. That it is often voluntary there can be no doubt; one ataxic patient for instance when given a spoon and told to place it in his mouth always brought his elbow down to his side and held it firmly applied to it before moving his hand towards his face, in order, as he explained, to control as well as possible the disorderliness of his movements. But my observations convince me that it is not always intentional, at least in its milder forms, and that it may be a result of faulty association in time and degree of the various muscular contractions that are concerned in the action.

The symptoms described under the term *dysmetria* are more difficult to interpret. Luciani, who introduced this term, regarded it as a natural consequence of atonia ; according to him the excessive elevation of the leg is due to a too sudden relaxation of the extensors as the flexors contract, and he therefore refused to accept it as a primary cerebellar symptom as Schiff had previously considered it. Babinski, who has pointed out its importance in clinical symptomatology and the fact that the movements are generally excessive in range, admits he does not understand its nature, though he suggests that it may be due to removal of an inhibiting or braking function ("action frénatrice") of the cerebellum. André-Thomas regards dysmetria as the most important factor in the disturbance of movement; he formerly assumed (1911) that the influence of the cerebellum is manifested in moderating the voluntary impulse, and not in causing the antagonistic muscles to intervene, but later he has attributed it, as well as most of the other symptoms, to anisosthenia ; the movement is excessive because the hypersthenic muscles contract too vigorously, and because it is arrested too late or insufficiently owing to the hyposthenic state of their antagonists. I have observed no facts that support this explanation, nor is it intelligible to me how hypermetria would, on this hypothesis, result from extensive lesions or widespread disease which must involve numerous pairs of his reciprocally functioning "dynamogenic centres." Further, movements in opposite directions at the one joint are generally both hypermetric; and, as Babinski has pointed out, excessive movements are common in chronic cerebellar disease in which there is little or no demonstrable atonia.

The main cause of hypermetria is the pathological slowness in commencing and in completing the relaxation of the contracting muscles. While delay and slowness in starting contractions may cause no pronounced disturbance of voluntary movement, a delay in the arrest of the contraction and a slowness in affecting relaxation must necessarily prolong the movement or continue it too far, and consequently make its range too great. In several of the latter cases of my series this explanation was carefully tested and in all it was found that when there was a definite tendency to hypermetria in any movement the muscles which effected it relaxed more slowly than their homologues in the normal limb.

It often seems, however, that the exaggerated movements are to some extent due to the failure of their prompt arrest by the contraction of their antagonists; when, for instance, towards the completion of the action the limb moves with gravity it is often allowed to fall inertly on the object it wishes to seize. The timely intervention of the antagonists is then absent, as it is in the rebound phenomenon, but this cannot be attributed to their hypotonia, as André-Thomas suggests, for the proper co-operation of agonists and antagonists is an integral factor in voluntary movement, and depends on the co-ordination of the subcortical centres that effect it.

But the mismeasured movements are occasionally too small. This may be due to intentional arrest—we have, in fact, seen that this often occurs—or to an under-estimation of the effort necessary to move the slow and asthenic limb; but it is chiefly a result of the defective co-ordination of the various muscles concerned in the act, which necessarily disturb its range as well as its direction.

The deviation from the correct line of movement, which is prominent chiefly in early injuries, is a natural result of the functional disturbances which have been already considered. The limb deviates, especially in the early part of the movement, because the muscles that should be employed in fixing certain of its joints and in maintaining its correct posture contract inadequately or too late. Further, since the co-operation of those concerned in it, whether they contract or relax, is no longer accurate, the moving limb is not brought in the most direct line to its object, even though the general direction of its movement is correct.

All these disturbances are well brought out by Babinski's tests for adiadochokinesis. Rapid alternate movements are slowly, awkwardly, and irregularly performed, owing to the slowness in the initiation of each, the irregularity in their range and the disturbance in the normal co-ordination of the muscles that should contract, those that should simultaneously relax, and those that should assure the correct posture of the limb. The more rapidly the movements are performed the greater is the need of accurate co-ordination, since any irregularity or defect in one must also influence the proper execution of the succeeding movements.

The same factors are responsible for the affection of speech; its slurred, indistinct, and scanning character results from the imperfect harmony of the movements and attitudes necessary in normal phonation and articulation, while the tendency to explosiveness may be regarded as a manifestation of dysmetria. The unnatural efforts which the patient puts into his attempts may be more easily interpreted as an attempt to control voluntarily the disturbances of the complex and highly specialized mechanism of speech, rather than to asthenia of the muscles of phonation and articulation. The grimaces and unnecessary contractions of the facial and neck muscles in a patient with a severe cerebellar injury often recall those that occur on the inco-ordinate attempts of a mild stammerer to speak.

We must consequently conclude that, in addition to its influence on tone, and that by which it assures the regularity and maintenance of muscular contractions and the immediate and effective response of sub-cortical mechanisms to cerebral impulses, the cerebellum also exerts a regulating and co-ordinating influence on the spinal centres that effect voluntary movements and by this means assures their harmony, precision and correct range. This does not mean that the cerebellum

puts into play the muscles necessary for the accomplishment of complicated movements. It is an organ which has evolved on the afferent rather than on the motor side of the central nervous system. But it receives and integrates proprioceptive impulses from all parts of the body, and by virtue of these it keeps the motor mechanisms in such a state of "tone" that it can react promptly and efficiently to reflex and voluntary impulses, and assures the correct co-operation of the separate motor centres that are concerned in individual acts.

After a recent injury of one side of the cerebellum the eyes when at rest tend to deviate towards the opposite side, and nystagmus occurs on movement and especially on accurate fixation. This deviation of the eyes, the greater effort necessary to move them towards the injured side, and the frequent defect in the range of movement in this direction, must be attributed to loss of an influence, probably of a reinforcing nature, which each half of the cerebellum exerts on conjugate deviation towards the same side. The effect of this loss is most evident in voluntary movement, but it may be seen, too, in the adjustment of the eyes when the head is passively rotated, and when they move reflexly to a sudden visual or auditory stimulus. As an analogous deviation is produced by unilateral labyrinthine extirpation it is probable that this function of the cerebellum depends largely on its labyrinthine afferents, but since in this condition the deviation of the eyes is towards the injured labyrinth, and the associated nystagmus differs in type, it is evident that the eye symptoms of cerebellar disease are not due merely to interruption of labyrinthine impressions; it has, in fact, been found by experiment that the impulses by which the labyrinth influences the ocular movements do not pass through the cerebellum. (Wilson and Pike.)

Further, both the nystagmus and the paretic deviation produced by cerebellar lesions, though not permanent, are more persistent than when the vestibular apparatus only is destroyed. It is probable that it is to the combination and integration in the cerebellum of labyrinthine and other proprioceptive afferents, especially those from the ocular, and possibly from the neck muscles too, that this influence on the movements and position of the eyes is due.

The *nystagmus* is closely related to this symptom. When a patient attempts to look towards the injured side the eyes are brought over quickly, but they soon recede more slowly towards the middle line as though the muscles were too weak to maintain the position, and are then jerked back again in the desired direction. A series of these recessions and corrections constitutes nystagmus. It consists of a slow phase towards the position which the eyes assume when at rest, and a quick phase in the direction towards which they should be moved voluntarily. The range of both excursions increases the farther the object to be fixed is

from the middle line, that is, it is proportional to the effort necessary to bring the eyes into, and keep them in the correct position. The essential feature is the slow recession, which is only a manifestation of the spontaneous deviation, while the quick phase can be regarded as an attempt at correction. It has been shown by Wilson and Pike that in labyrinthine nystagmus the quick jerks are of cerebral origin, and the same is probably also true of cerebellar nystagmus. There can be no doubt that this is always more marked when the patient makes a voluntary attempt to fix an object than when his eyes are at rest or moved to order. It is interesting that nystagmus is more pronounced and more persistent in man than in animals; this is probably related to the greater development of the forebrain, and to the larger part that this takes in the execution of ocular movements.

The nystagmus that occurs on central fixation is similar. The eyes still tend to recede towards the healthy side, and their recessions are corrected by similar sharp abrupt jerks. It is important in support of the above explanation, that nystagmus on central fixation is pronounced only when a tendency to spontaneous deviation exists.

On full deviation towards the unaffected side and on vertical movements a similar nystagmus may also occur, the slow phase being towards the primary central position, or more correctly towards that point in space to the healthy side of it on which the eyes tend to deviate when at rest. It consequently seems that each half of the cerebellum has an influence, not only on conjugate movements of the eyes towards the same side but also on vertical movements and on full deviation towards the opposite side. This influence is probably closely allied to that by which the normal labyrinth assures the adjustment of the eyes to change of the position of the head in space, and is adjunct or reinforcing to the processes which effect voluntary deviations and reflex ocular movements of other origin. That this reinforcing action should be more pronounced in the ocular movements than in those of the trunk and limbs is not surprising when the greater extent to which the ordinary movements and adjustments of the eyes are dependent on subcortical mechanisms, and especially on labyrinthine impressions, is realized.

This type of nystagmus cannot be regarded as an ataxia of the ocular muscles; it is usually a well co-ordinated phenomenon in which the co-operation of the various muscles concerned in movement and fixation is undisturbed, though it may be occasionally seen that the adjustment of the visual axes to the object that should be fixed is imperfect.

The mode in which lesions of the cerebellum influence the posture of the head, trunk and limbs is more obscure. Those abnormal postures that result from unilateral lesions are much less marked and less persistent in

man than in animals, and even in these physiologists have not yet reached any definite or generally accepted hypothesis as to their nature.

The most striking and constant of the abnormal attitudes is that assumed by the head and the tendency of the affected limbs to deviate when unsupported and in movement (Bárány's pointing test). The head is as a rule inclined towards the injured side and rotated to the opposite, so that the occiput approaches the homolateral shoulder. It is noteworthy that this position also occurs after destruction of one labyrinth, and Horsley has indeed suggested that it should be regarded as a labyrinthine rather than a cerebellar attitude. It may be that it is through the cerebellum that the labyrinth exerts this posture influence.

The deviation of the limbs when unsupported and in movements uncontrolled by vision is a more important problem, since Bárány and André-Thomas have laid much emphasis on it in discussing the normal functions of the cerebellum. I have not been able to observe the anisosthenia to which Thomas and Durupt attribute it, and to explain it by the relative hypertonicity (that is, excessive tonic state) of certain groups of muscles and hypotonia of their antagonists, is, unless this condition of tone can be detected by other tests and in other movements, merely to restate the question. Since analogous deviations are produced by labyrinthine lesions, Bárány's conclusion that they are due to the interruption of labyrinthine impulses in the cerebellum is plausible.

The tendency to fall and to deviate to the injured side in standing and walking are analogous symptoms, which may be attributed to loss of motor balance between the two sides of the body owing to the removal of an influence which each half of the cerebellum elaborates mainly from labyrinthine impressions. The other disturbances of equilibrium and of gait are due to those abnormalities of movement seen in all actions of the affected limbs, and which are more pronounced the more complicated and delicate the action is, and the greater the number of muscles it employs. My observations lend no support to the view held by many physiologists and clinicians that the predominant function of the cerebellum is the maintenance of equilibrium.

Functional Localization in the Cerebellum.

The experiences of this war will probably settle the question of localization in the human cerebellum, or rather in its cortex.

It must be admitted that the results of physiological experiments are strongly in favour of it. Sir David Ferrier's electrical stimulations, Bolk's anatomical researches, and the observations of numerous physiologists as van Rynberk, Rothmann, André-Thomas and others, on the symptoms produced by small circumscribed lesions, seem at first sight to prove conclusively that a localization of function does exist in the cortex.

But when they are more carefully examined so much discrepancy is found, even between the results of experiments made in the same animal class, that they are less convincing.

Further, Horsley and Clarke's careful researches have shown that the cerebellar cortex is inexcitable to electrical stimuli ; and many of the local lesions from which the most definite conclusions have been drawn extended to or involved the nuclei. And even a constant correlation between structure and functional adaptation is an unsafe argument, though a valuable guide, for the physiologist.

My own observations are of only negative value. I have attempted to determine the position of the injury in every case by careful observation at the time of operations, by a study of radiographs which revealed penetrating fractures of the skull or the presence of foreign bodies in the cerebellum, and by post-mortem examinations. For this purpose it was necessary to learn the relation of various points on the surface to underlying parts of the cerebellum ; this was done by modelling plasticine to represent the covering scalp and soft tissues, on to a dried anatomical skull in which a cerebellum was placed. When the position of the entrance wound and its direction were known, an approximate idea of the region injured could be then obtained.

In many cases the primary wounds were large, and the softenings, hæmorrhages and septic processes that so frequently accompany such injuries undoubtedly increased the extent of the destruction. In others, however, only small local lesions probably existed ; in three men, for instance, the missiles, a small shrapnel ball and fragments of shell casing respectively, were merely embedded in the skull, but on removing them small lacerations were found in the dura mater through which some softened cerebellar tissue escaped, and in several other cases similar circumscribed lesions were produced by small depressed fractures.

On investigating the sites of the wounds it was found that the majority involved the posterior-inferior surface of the cerebellum, most were in fact referred to the lobus gracilis, but practically every region except the anterior-superior margin was affected in one or more cases. In two patients, for example, depressed fragments of bone were driven along the under surface of the tentorium, so that the injury was almost limited to the superior surface, and in several others this surface was wounded by missiles which had entered through the occipital or parietal lobes and had penetrated the tentorium. In a few cases missiles of higher velocity had passed through different portions of the cerebellum. In some patients the lesions were more or less mesial, in others they involved its lateral part.

Final conclusions on localization can be drawn only from cases controlled by complete anatomical examinations. But, on the other hand, if there is a focal localization of function in the cortex some definite evidence of it should be obtained from such material as has been available

to me for investigation. Of such localization I could, however, find no certain evidence. When small superficial lesions existed, they produced only slight and transient symptoms which were never limited to one segment of a limb, or even to one limb. On the other hand, unilateral lesions produced symptoms which were always limited to the same side, and we can consequently assume that the functions of the cerebellum are always limited to the same side of the body.

It is true that the muscles of the head, neck and trunk, including those concerned in phonation and articulation, are more seriously affected when the vermis is injured, and disturbances of their function are usually more obvious in mesial than in lateral lesions of one lateral lobe; it is therefore probable that these activities, which require the co-operation of homologous bilateral muscles, are represented in or near the vermis.

A special interest has been given to the question of functional localization in the human cerebellum by Bárány's publications. According to his views there exist centres for the direction of movement in the cortex, and a further representation of muscles, according to the articulations they move, within these centres. He has come to this conclusion after investigating the deviations of the affected limbs when they are unsupported and in movements which are not controlled by vision, and from the fact that when local lesions exist the deviations in certain directions which are normally produced by stimulation of the labyrinth no longer occur. I have found however that a unilateral injury of any part of the cerebellum almost invariably causes deviation, both spontaneous and in the pointing test, of the homolateral arm outwards, while the vertical errors are frequently inconstant. Rothmann and others have also drawn attention to the frequency of outward deviation. Since in my cases many different regions of the cerebellum were involved, these facts are difficult to assimilate with Bárány's hypothesis of distinct focal centres for movement in different directions.

As the majority of my patients remained under observation for only relatively short periods after the infliction of their wounds it was rarely possible to test the rotation or caloric reactions. In three cases, however, both were examined, and in these it was found that immediately after the appropriate labyrinthine stimulation the homolateral arm, which had previously deviated outwards, no longer showed any tendency, or less tendency, to deviate in vertical movements; in other words, the normal reactions were not abolished, but instead of producing deviation inwards they merely corrected the outward deviation which previously existed.

The same condition was found in two other men whose cases are not included in this paper. One had been wounded in the head twenty months previously and had been operated upon. No information on the nature of the injury or on the extent of the operation could be obtained,

but there was a trephine opening over the right half of the cerebellum. He came under observation with unmistakable symptoms of disseminated sclerosis and had probably a large plaque in the region of Deiters' nucleus. There was a marked tendency to spontaneous deviation of his right arm inwards and to progressive deviation in this direction in vertical movements, which increased after rotation to the left and on irrigation of his left ear with cold water, but disappeared on rotation to the right and on irrigation of his right ear. The irrigation of his left ear with cold water in the case of a second patient whose right half of the cerebellum had been extensively injured eight years previously also only corrected the constant deviation of his right arm outwards.

If these observations are confirmed Bárány's conclusions cannot be accepted that local cerebellar lesions abolish certain deviations of the limbs which are normally produced by stimulation of the labyrinth, since these can still be elicited, though the error in movement is masked by an actual or by a latent tendency to deviation in the opposite direction, which is due to the cerebellar wound.

But though my observations lend no support to the theory of focal localization of function in the cerebellar cortex they cannot be accepted as proof that such localization does not exist.

There can be, however, no doubt that the relative prominence of different symptoms, as tremor, slowness and inco-ordination of movement, as well as nystagmus, varies with the site of the lesion. I hope to deal with the question in a later communication.

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OBSERVATIONS ON 250 CASES OF GUNSHOT WOUNDS OF THE PERIPHERAL NERVES.

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Between June, 1915, and March, 1918, 364 cases of injuries of the peripheral nerves have been admitted to the surgical division of the Norfolk War Hospital; 250 cases have come under my observation, and of these 102 cases have required operative treatment. It is chiefly upon these cases that this paper is based. An attempt has been made to follow up the cases, and to show the result obtained by operation up to the present time.

Clinical Features of Nerve Injuries.

In every case of a gunshot wound of an extremity, it is of vital importance to examine the limb for evidence of injury to the peripheral nerves. No examination of a fracture would be considered complete without an X-ray. No examination of a gunshot wound of a limb is complete without an examination of the nerves of the limb. It is of great importance that a diagnosis of a wounded nerve should be made at the earliest possible time, so that an attempt may be made to prevent the development of a useless, deformed, and contracted limb. The injuries inflicted on nerves by gunshot wounds are very variable, but by a careful consideration of the signs and symptoms produced it is possible to recognize several distinct types of lesions. The clinical progress in a large number of cases may be said to fall into one of the four following syndromes :—

(1) The syndrome of complete division of a nerve trunk. The signs and symptoms vary necessarily with the functions of the affected nerve, but taking as an example a mixed sensori-motor, such as the median or musculo-spinal nerve, the following phenomena may be observed.

Motor Phenomena.—There is immediate and complete loss of voluntary power in the muscles supplied by the divided nerve. The paralysed muscles waste and undergo degenerative changes which result in wasting and deformities known as paralytic contractions.

Sensory Phenomena.—There is loss of protopathic sensibility. Protopathic nerves respond to painful skin impressions, e.g., the prick of a pin, and the distinction between extreme degrees of temperature. Their area of distribution is badly localized, and stimulation of them gives a widely radiating tingling sensation.

There is loss of epicritic sensibility. Epicritic nerves respond to light touches, and also distinguish small difference of temperature. Their area of distribution is well defined.

Vaso-motor Phenomena.—It is stated that there is an initial rise in the temperature of the limb after the division of a nerve, with some redness and increased vascularity in the part. This is usually followed by a fall in the temperature of the part. The limb becomes pale and cold. It is often found that the temperature of the injured part varies very much with external influences—in cold weather, for instance, the injured part may assume a cold bluish appearance.

Trophic Phenomena.—A considerable time often elapses between the time of the injury and the appearance of well-marked trophic lesions. Sometimes trophic lesions will develop even after an operation has been done for the union of the divided nerve. There is a diminution in the quantity of the subcutaneous fat, the skin becomes smooth, and may be abnormally dry, the hair is harsh and dry. Often blisters develop as the result of trivial injuries, and in some cases the tips of the finger may disappear as the result of progressive ulceration. Degenerative changes also occur in the bones and small joints of the hand.

(2) *The Syndrome of Compression.*—This is an important group and contains a considerable number of cases. If the signs and symptoms in these cases be carefully considered, it will be noticed that there has sometimes been some improvement, but after a time this ceases and there may be a relapse. This relapse is almost always due to compression of the nerve by fibrous tissue, or the development of callus. Early diagnosis in these cases is very important, as they are the most favourable for operative treatment. A definite syndrome has been observed in these cases by Stopford. This syndrome consists of a dissociated type of sensory disturbance. The area in which there is a loss of sensibility to pain (tested by a pin-prick) is greater than that in which the loss to light touch occurs (tested by camel-hair brush). This syndrome is the reverse of that enumerated by Head, Rivers, and Sherren for injuries of the peripheral nerves. It is said not to be present on examination of recent injuries, but only develops at a later date. In cases of compression the motor paralysis is less marked than in cases when the nerve has been divided, and the muscular wasting is also rapid and not so extensive. Trophic lesions do not occur in cases of compression.

(3) *Syndrome of Incomplete Lesion with Irritation.* — When this condition is present the patient often complains of neuralgia pains. On examination the extremity shows a glossy shining, and mottled red skin which is often tender to stimuli. The skin in such cases is usually drawn tightly over the fingers, the subcutaneous tissue is small in amount. There is generally profuse sweating over the area of the nerve affected. The sweat is strong smelling and markedly acid in reaction. Sweating is usually not excessive, unless there is an irritative incomplete lesion.

(4) *The Syndrome of Interruption, followed by Restoration of Function.* —The cases following this course are probably examples of physiological division. The missile having passed close to the nerve and temporarily

paralysed it, there is loss of sensation and of motor power, but there is usually little or no muscular wasting. In a few weeks there is usually evidence of returning sensation, and this is followed by the restoration of tone and voluntary contraction in the paralysed muscles. These cases usually recover completely in about three months.

MACROSCOPIC PATHOLOGICAL LESIONS OF PERIPHERAL NERVES, DUE TO INJURY, WITH SPECIAL REFERENCE TO THE SYMPTOMS CAUSED AND THE TREATMENT NECESSARY.

(*A*) *Lesions of Nerves which give rise to Interruption of Function with Subsequent Recovery.*—The pathological lesion in these cases is usually one of concussion of the nerve. The missile has passed through the limb near the situation of the nerve, without causing any macroscopic lesion. The nerve has been merely concussed, or perhaps temporarily stretched. With careful treatment these cases usually recover completely. In other cases the missile may have caused some perineural hæmorrhage. This compresses the nerve for a time, but on its absorption recovery takes place. Operation in these cases is not required, recovery takes place in from two to six months.

(*B*) *Lesions of Nerves which give rise to Interruption of Function with Incomplete Recovery.*—The following pathological conditions often give rise to incomplete recovery when not subjected to operation :—

(1) Concussion of the nerve with perineural suppuration which gives rise to the formation of fibrous tissue.

(2) Partial neuromata which probably result from endoneural hæmorrhage.

(3) Laceration of the nerve sheath with adhesions to the surrounding structure.

(1) Concussion of the nerve with suppuration in the surrounding tissue often gives rise to incomplete recovery, and this is extremely likely to happen when insufficient drainage of the wound has been established. Excessive formation of fibrous tissue takes place, and the nerve is partially compressed by its development.

(2) The development of partial neuromata is a condition which probably results from endoneural hæmorrhage. The condition is recognized by feeling a hard fibrous nodule, situated in a nerve which has been subjected to injury. Recovery in these cases may be incomplete, but the prognosis is good in those cases where there is only a partial loss of function. No attempt should be made to excise these swellings, when only a part of the nerve is affected, but the nerve should be placed in a bed of healthy tissue.

(3) Laceration of the nerve sheath with adhesions to the surrounding tissue. This condition is often associated with the signs and symptoms of an incomplete lesion, with evidence of nerve irritation. The condition

results from the nerve sheath having been torn by the injury, and inflammation following the injury gives rise to adhesions which bind the nerve down to the surrounding structures. An operation should be performed, and the nerve freed from adhesions, and placed in a bed of healthy tissue.

(*C*) *Lesions which Destroy Nerve Function :—*

(1) Complete division.

(2) Compression.

(3) The development of a complete neuroma without resolution, that is the development of fibrous tissue in the nerve prevents regeneration of the nerve taking place.

(1) *Complete Division.*—In many cases of injury the nerve is completely divided. The gap between the ends of the divided nerve varies much according to the severity of the injury, and the amount of tissue damaged. The cut ends of the nerve probably retract, and the gap is filled by a firm homogeneous mass of scar tissue. The amount of scar tissue depends upon the amount of suppuration. The greater the amount of suppuration, the greater the amount of scar tissue. The development of scar tissue as the result of suppuration, probably in all cases, forms a barrier, which prevents the nerve ends uniting without surgical aid. If the wound is aseptic, the ends of the divided nerve become united, and the conducting paths are re-established by a regeneration of nerve tissue (Thomson and Miles's "Manual of Surgery," vol. i.). This is not likely to happen, because when a nerve is divided its ends usually retract, even when the wound remains aseptic. But that it is possible is suggested by the following case :—

Case 1.—Injury to the left wrist, symptoms and signs of division of the ulnar nerve. Operation refused. Spontaneous recovery.

Private F. McN. was admitted to the Norfolk War Hospital on November 1, 1916. The patient stated that two months previously, September 1, 1916, he cut his wrist by falling on some barbed wire; the cut was a deep one, and he lost the sensation of the fourth finger, and the ulnar side of the third finger.

Condition on admission to the Norfolk War Hospital, November, 1916 : Examination of the left upper extremity, there was a healed wound at the upper border of the anterior annular ligament over the situation of the ulnar nerve. There was absolute loss of sensation over the area supplied by the ulnar nerve in the left hand. The muscles supplied by the ulnar nerve showed obvious signs of wasting. There was loss of power in the hand, and on electrical examination the muscles supplied by the ulnar nerve showed the reaction of degeneration. The diagnosis of division of the ulnar nerve was made, and operation advised. The patient refused operation. He was, therefore, treated with massage and electricity. The hand continued to waste, and showed the typical appearance of division of the ulnar nerve. At the end of four months, January, 1917, there was some improvement, and on examination of the healed wound a well-marked thickening could be felt in the course of the ulnar nerve; three weeks later

and twenty weeks from the date of the injury the patient stated that he thought he had some return of sensation in the hand. The condition of the hand was certainly improving.

At the proximal end of a divided nerve a terminal neuroma will develop. This bulbous end is firm, hard, and paler in colour than the normal nerve. It is composed of partly fibrous and partly nerve tissue. The development of a terminal neuroma is usually good evidence that the nerve has been divided. Its size and development appear to be dependent upon the condition of the surrounding tissues. Where there is much hard and dense fibrous tissue surrounding the ends of the divided nerve, the neuroma will be small and ill developed; when the tissues are lax and free, and where little fibrous tissue is present, it is probable that the terminal neuroma will be large and well developed. The upper extremity of the distal end is often shrunken, flattened, spread out, and difficult to define. The whole peripheral part of the divided nerve may be thin and wasted.

An operation is urgently needed in the case of a divided nerve. The ends should be brought together and united as soon as possible.

Closely allied to the terminal neuroma is a condition which may be described for convenience as a complete neuroma. This condition is occasionally met with as a result of a severe injury to a nerve. On careful observation of the nerve it is found that there is no break in its continuity, and that its course is interrupted by a hard spindle-like thickening. In other words, there is no firm homogeneous mass of scar tissue, such as is found separating the ends of a divided nerve, but that the nerve is continuous, except for the spindle-shaped swelling.

These cases require the most careful consideration in their treatment. If the complete neuroma is associated with loss of sensation which has been present for more than eight months, with progressive muscular wasting and contraction of the muscles, then the best treatment is to excise the swelling and bring the ends of the nerve into apposition. If, on the other hand, the signs and symptoms do not seem to be progressive, the muscular wasting is only slight and not progressive, and there are no contractions, then it is best to be content to place the injured nerve in a bed of healthy tissue, or to surround the seat of the lesion by a flap of fat.

In a paper on gunshot wound of peripheral nerves, Stockey writes thus: "The temptation to excise all hardened tissue about the nerve may lead one into greater difficulties and prolong convalescence. We know that nerve fibres will grow through considerable tissue resistance. If then, at operation this be borne in mind, and in place of free excision in suitable cases the nerve may be freed and wrapped in with a flap of fat or other suitable tissue, recovery is more rapid and more complete."

To sum up, partial neuromata require protection. Complete neuromata with progressive signs and symptoms require excision.

(2) *Compression.*—The chief causes giving rise to compression of nerve

are severe injury with marked suppuration in the course of the nerve. Compression is most likely to result in cases where there has been excessive suppuration with insufficient drainage. When a nerve lies in close relation to bone (for instance, the musculo-spiral in close relation to the humerus), the formation of callus, with the subsequent implication of the nerve, is a common cause of compression. These cases should be operated upon at the earliest possible moment. These are the most favourable cases, the prognosis being always good. The nerve at the site of compression will look a little thinner than the rest of the nerve. In appearance it will look a little whiter than the non-compressed part of the nerve, and on palpation it will feel somewhat dense and firm. Recovery in these cases is rapid after the compression has been relieved, and the damaged part of the nerve has been placed in a fresh bed or some soft tissue wrapped around it.

Time of Operation, Indication and Contra-indication for Operation.

Suture of nerves may be primary or secondary. Much has been written about primary and secondary suture for war wounds, which has been made possible by the aid of the Carrel-Dakin treatment, and by the use of bipp. Nothing or very little has been written about primary suture of nerves. In this series of cases there have been only two cases of primary suture. In one of these cases it was found necessary to again operate and perform secondary suture.

Cases.

Gunshot wound of the left forearm, resulting in laceration of the muscles and division of the ulnar nerve. Excision and repair of the wound, primary suture of ulnar nerve (March 9, 1917). Operation followed by marked suppuration and wound broke down. Secondary suture of ulnar nerve, August 30, 1917.

R. E. received a severe flesh wound of the left arm on March 9, 1917. An operation was done on the same day at a casualty clearing station. The wound was excised, repaired, and the ulnar nerve sutured. The wound broke down and suppuration was present for a considerable time. Eventually the wound healed. The patient was admitted to the Norfolk War Hospital on August 2, 1917, five months after being wounded. His condition on admission was as follows:—

Examination of the left upper extremity; there was loss of sensation over the area of the distribution of the ulnar nerve in the hand, the muscles supplied by the ulnar nerve also showed evidence of wasting. They do not react to electrical stimulation, the hand was weak, there were no broken lesions. The diagnosis of division of the ulnar nerve was made, and although primary suture had been done, it was considered this had been a failure, owing to the marked suppuration which followed the operation. On August 30, 1917, an operation was done, the ulnar nerve was explored,

and it was found united by about ½ inch of dense scar tissue. This was excised and the ends brought easily together without tension. There was no evidence of any nerve fibres passing through the piece of tissue removed. Since the operation progress has been satisfactory. There was little doubt that the primary suture made the operation of secondary suture a much easier operation in this case.

Case 3.—Gunshot wound of the right upper arm. Severe flesh. Drop wrist. Operation. Recovery.

P. P. was admitted to the Norfolk War Hospital on August 7, 1915. He had been wounded August 2. On examination there was a severe flesh wound of the right upper arm. There was marked septic infection of the wound. No injury of the bone was detected. There was wrist drop. An operation was performed on August 8, the wound was laid freely open, and the musculo-spiral nerve could be seen lying in the floor of the wound. It had been partially torn. One suture was put into the sheath of the nerve in order to draw the torn part of one nerve together. The patient recovered the power of his wrist after eight months, but there was still partial loss of power in the extensors of the second and third fingers.

On general principles it would seem useless to attempt primary suture of a divided nerve, but primary suture, when the nerve can be seen lying in a wound, with the hope of making any secondary suture at the proper time a much easier operation, is most desirable whenever possible. The results of secondary suture might be much more successful, although more difficult to perform, if a primary suture has been done in the first place. Secondary suture is accompanied with much more difficulty than primary suture, owing to the greater retraction of the nerve ends, their bulbous or filiform extremities being buried in scar tissue, or matted to the surrounding structures. These difficulties increase with time, so that provided there be no contra-indications, the operation should be done at the earliest possible moment. In the case of a completely divided nerve the recovery of the nerve cannot start until the operation has been performed. In cases of nerves being slowly strangulated by fibrous tissue or callus, the compression may cause irreparable damage both to the nerve itself and to the tissue it supplies. The earlier the operation the better the result in these cases. Early operation is indicated in cases of (1) complete division, (2) cases of compression, (3) cases of incomplete division where progress is arrested, (4) cases of nerve irritation, (5) cases of pain.

It has been said that a diagnosis cannot be made between anatomical and physiological division in cases of nerve injury. In many cases this is true, but from observations on this series of cases it would appear that if a nerve lesion has not shown any signs of recovery within three or four months from the time of the injury, some macroscopic pathological lesion will be found on exploration of the nerve. This rule has only failed twice in this series of cases.

When there has been no bony injury it is advisable that the wound

shall have been absolutely healed for at least one month before any operation is performed. When there has been a septic bony injury it is often advisable to wait three months after the wound has healed before operating on the nerve. Septic infection means failure in these operations. Most surgeons are in favour of early secondary suture of divided nerves for the following reasons: The earlier the operation is done after the wound is soundly healed the better are the anatomical relations maintained. The amount of scar tissue is smaller in amount, and softer in texture, so that it is more easily removed. If the nerve is not divided and only imbedded in scar tissue, valuable tissue has been saved by the operation, and perhaps irreparable damage prevented. The longer the operation is delayed the firmer are muscular contractions, and the greater the atrophy and degeneration of muscles, and the more likely are trophic lesions to occur in the skin, muscles, bones and joints.

There are two contra-indications to operation, namely:—

(1) The wound is not yet healed.

(2) There are progressive signs of recovery in the function of the nerve.

Some neurologists hold that if an early operation is advised, a positive diagnosis cannot be made, the nerve may yet recover. There is very little to be said in favour of waiting for a patient to get worse in order to make a positive and complete diagnosis. No surgeon waits for a malignant growth to produce secondary deposits in lymphatic glands, why wait for a divided nerve to produce degenerative changes in muscles and trophic lesions? If there are sufficient signs and symptoms to suggest that the nerve has suffered some macroscopic pathological lesion which is amenable to surgery, an operation should be performed.

Pre-operative and Post-operative Treatment.

The operative treatment in these cases should be looked upon merely as an incident in the treatment of the case. The most skilfully performed operation on an injured nerve is doomed to failure, and can accomplish little if the pre-operative and post-operative treatment is insufficient or neglected. The treatment in these cases should extend over a period of many months. The results can only be good when treatment is commenced early and is conducted with great perseverance both on the part of the patient and on the part of those who are responsible for his treatment. It is often difficult or impossible in these cases to prevent such complications and trophic lesions making their appearance, but if no attempt be made to prevent and overcome these conditions irreparable damage will supervene, damage which no amount of surgery can be expected to correct. It is most important to try and make the patient realize the importance of treatment, and to make him understand how much he can do for himself to promote his recovery.

The treatment can be considered under the following headings:—

(1) Postural treatment.

(2) Electro-therapeutic treatment, including electric treatment, massage and exercise.

Much has been written with regard to the positions which should be maintained after a patient has suffered a lesion of a peripheral nerve, but it must not be considered that everything has been done when the patient's hand or leg has been fixed in the orthodox position by some splint. It often happens that these cases are complicated by some injury to the bones of the limb. A splint is applied, fixing the whole limb. Of the many inventions for the treatment of fractures, and especially those complicated by nerve lesion, all are bad which hinder the easy movement of the phalanges of the thumb and fingers. If the hand or the foot are left fixed in any one position for long periods, and passive movements are not frequently performed, disaster is certain to follow. It is quite as important to remove a splint often as it is to apply it at all. The nutrition of the muscles must be preserved as much as possible by massage and electrical treatment. Vasomotor lesions are of common occurrence in these cases, and it is often noticed that the limb affected is cold and clammy. It is most important to keep these limbs warm, especially is warmth important when electrical stimulation is being used as a method of treatment. It is futile to apply electrical stimulation to cold and blue extremities. The limb should previously be wrapped in warm cotton wool, or immersed in hot water for a few minutes.

Joints must be prevented from getting stiff by passive movements, which should have been begun as early as possible. Cases of stiff joints will often be much benefited by hot-air baths.

The condition of the skin itself must not be neglected, but must be suitably protected from any injury. In short, every tissue enervated by the injured nerve must have due consideration and treatment. Treatment should be regular and continuous. If operative treatment becomes necessary massage should be again started as soon as possible, and in the upper extremity every attempt should be made to prevent stiffness and contraction of the hand and fingers occurring.

A position of relaxation should be maintained in all nerve injuries.

In median nerve injuries, the muscles supplied by the nerve are relaxed when the fingers and hand are flexed, and the thumb abducted and flexed, the arm being slightly rotated. Good results in this hospital have been obtained in cases of simple uncomplicated lesions of the median nerve without the application of splints.

In ulnar nerve injuries, the muscles supplied by the nerve are relaxed, when the fingers are spread apart; the first phalanges flexed, the second and third extended and the thumb abducted. Every attempt has been made to prevent contraction, and to maintain a position of relaxation in lesions of the ulnar nerve, by means of splints and appliances, but more success has been obtained by massage and passive movements, than has been obtained by methods of fixation.

In lesions of the musculo-spiral nerve, by means of a Jones's "cock-up" splint, or some modification of it, the hand is hyperextended, the thumb abducted, and the arm put in a position of supination, so relieving the extensor muscles of all strain. Operations on the musculo-spiral nerve are doomed to failure if the paralysed muscles are allowed to become over-stretched and lengthened by allowing the wrist to be in the flexed position of "drop" wrist. If the wrist is kept in good position injuries of the musculo-spiral nerve are among the most favourable for treatment.

It is useful before leaving the question of massage, electrical and postural treatment, to answer the question: What can these methods of treatment do for a patient who has suffered a nerve lesion, and how long should such treatment be continued? Massage, electrical and postural treatment can prevent joints becoming stiff. It can prevent muscular contraction to some degree, and it can maintain the tone of the muscles; in other words, it can enable the parts to be kept in the most favourable condition for the resumption of their functions.

It can do little in late and neglected cases. One often sees hopelessly contracted limbs with paralytic deformities, and with muscles the seat of degenerated changes, sent to the massage and electrical department as a last resource. These cases should have been sent to this department for the prevention of these calamities, not for their relief, for the best massage and electrical treatment is often almost a waste of time in these cases. It is difficult to lay down any definite rules and say how long treatment should be continued. Most cases show some improvement within six months. Massage and electrical treatment should be continued for at least six months after the operation on a nerve has been performed. It is unlikely that treatment for more than a year will give rise to much improvement.

Operation.—The operative procedure may be considered under the following headings:—

(1) The skin incision.

(2) The isolation of the nerve trunk above and below the site of the lesion.

(3) The freeing of the nerve at the actual site of the lesion.

(4) Passing the sutures, and the exact co-aptation of the ends of the divided nerve.

(5) The formation of a sheath at the site of the lesion.

(6) Suture of the deep fascia and closure of the wound.

An operation having been decided upon, it should be performed under general anæsthetic. The whole arm or leg to be operated upon should have been previously prepared with the utmost care, any lesion of the skin being an absolute contra-indication to the operation. It is a great advantage to have a third assistant, whose only duty it is to control the position of the arm or leg, and hold it in any desired position. This is especially advantageous when operating upon such nerves as the musculo-

spiral. The operation is best performed without the application of an Esmarch bandage. Any hæmorrhage which may occur is easily controlled by the application of forceps, and the wound, when closed, is left dry, there being much less risk of the development of any hæmatoma, a very undesirable complication. The skin incision should be of ample length; for instance, in operating on the ulnar nerve in the forearm, it is best to make an incision from just below the elbow to just above the wrist; the skin having been divided its edges are protected by thin rubber sheeting or gauze attached by means of clips. If possible, the skin incision should be planned so that it avoids the old scar, or the scar should be excised. Excision or freeing the scar should always be practised wherever possible; the deep fascia is next divided, and any bleeding points controlled.

The nerve trunk is sought above and below the point of severance, and it is traced downwards and upwards to the lesion. In doing this the tissue surrounding the nerve should be dissected away from the nerve, and the nerve itself should be handled as little as possible. On exposure of the injured part of the nerve a bridge of fibrous tissue is usually found joining the ends together; it is best to dissect this quite free before attempting to determine whether the nerve has been divided or not, so that when the nerve has been completely freed its continuity has not been divided during the operation. The fibrous tissue is then dissected off the nerve, and a decision arrived at as to the pathological condition present. When the conclusion is arrived at that the nerve has suffered anatomical division, and its ends are only joined by a fibrous band, one very fine silk suture is passed vertically through healthy parts of the upper and lower ends of the nerve to be joined. This suture is a great aid in maintaining the exact co-aptation of the nerve when suturing it after removal of the intermediate fibrous tissue. Different bundles of the nerve have different functions, so it is most important to bring the corresponding bundles together in the suturing. The nerve at the site of the suture should be handled as little as possible. After the primary suture has been passed, the supposed fibrous band is divided, and sections are cut from its distal and proximal ends until nerve fibres are seen. The primary suture is then tied, bringing the ends of the nerve into exact apposition; a series of sutures unite the nerve sheath. It is most important to avoid tension.

I use the finest silk and the finest needles for suturing the ends of divided nerves. Catgut is the material usually recommended. It appears to me that the exactness and security of the junction is more important than the suture material used to perform and make it. The necessity of the formation of a sheath at the site of junction has next to be considered. The nerve, after suture, should be placed in a bed of healthy tissue; if this can be done, it will not be necessary to surround it with any foreign tissue.

Much has been written with regard to the surrounding of sutured nerves with some material supposed to have protective virtues—a piece of

fat, a piece of vein, cargile membrane, a piece of peritoneum from a hernial sac, have all been recommended. A piece of fat of moderate thickness cut from the patient's own thigh, and loosely sutured round the nerve so as to protect the site of suture, makes an ideal covering and bed when much scar tissue is present. If the operation is done aseptically the procedure has everything to recommend it. It is advised by many surgeons, and condemned by others, but the researches of Bittrolp appear to prove that it is a sound and scientific procedure. It is doubtful if the aseptic introduction of a piece of the patient's own fat can ever be harmful, it is almost certain that it is often of great service. On completion of the suture any bleeding points are carefully tied with catgut, and the wound thoroughly irrigated with warm saline solution. The deep fascia is carefully sutured with catgut and the wound closed without drainage. The arm or leg is then carefully bandaged. The limb should be placed in the best position to relieve the nerves from tension, and it should be fixed in such a position by splints and bandages. Massage for the hand should be started two or three days after the operation.

Complications.—The chief complications met with in this series of cases have been :—

(1) Those due to septic infection of the wounds, extensive destruction of the soft parts and sévere injuries to the bones.

(2) Extensive destruction to the nerve, resulting in a gap in its continuity, making end-to-end suture impossible.

(3) Drainage and rest for the inflamed parts have been relied on chiefly to overcome the septic complications. With thorough drainage the wounds have usually healed well, and given rise to little trouble. In a certain number of cases of severe infection, associated with marked swelling and œdema of the limb, it has occasionally happened that owing to the pain it has been impossible to prevent some stiffness of the fingers, due probably to the inflammation spreading to the tendon sheath. In such cases, after all the signs of inflammation have disappeared it will be found that much benefit will be derived from gentle but firm movements of the parts under an anæsthetic. The following case illustrates how much good can occasionally be done by gentle movements under an anæsthetic.

Case 4.—Gunshot wound of the right arm. Compound fracture of the radius. Division of the ulnar nerve. Operation. Secondary suture of the ulnar nerve, followed by stiffness of the fingers. Anæsthetic—movement of fingers. Improvement.

J. G. was admitted to the Norfolk War Hospital on May 8, 1917. On examination of the right upper extremity he was found to be suffering from a compound fracture of the right radius, and an injury to the ulnar nerve. On June 19, 1917, an operation was done, the ulnar nerve explored, and found to have been divided. The divided ends were dissected from scar tissue, the ends refreshed and united. The operation was not followed

by any marked improvement. In January, 1918, in spite of daily massage and electrical treatment, the fingers of the right hand had become stiff and almost motionless; any attempt to move them apparently caused great pain. In February, 1918, an anæsthetic was given, and the fingers gently but forcibly moved. This was followed by marked improvement in the movements of the hand and fingers, and on leaving the hospital in March, 1918, the patient possessed a moderately useful hand.

In cases associated with compound fractures, very careful treatment is necessary if necrosis with the development of a persistent sinus is to be avoided, which may delay the suture of the nerve for many months. These cases should be thoroughly drained at the earliest possible date, and all loose pieces of bone which have not firm attachment to periosteum removed. A healed wound must be obtained at the earliest possible time in cases of compound fracture complicated by nerve lesions. Carrel-Dakin treatment or continuous irrigation should be used as a method of treatment when necessary.

(2) Extensive destruction of the nerve, resulting in a gap in its continuity, making end-to-end suture impossible.

End-to-end suture is the operation of choice. It should be done whenever possible. It will usually be found possible to perform end-to-end suture after considerable pieces of nerve have been destroyed, if sufficient attention be paid to the following points: (1) The incision should be of ample length, so that the nerve may be separated from the surrounding structure, both above and below the lesion; (2) in lesions of the ulnar nerve, it can be displaced in front of the internal condyle of the humerus; (3) during and after the operation the position of the limb should be put in that of maximum relaxation so that all tension is taken off the nerve.

When it has been found impossible to perform end-to-end suture, a variety of procedures have been attempted and advised, but it would appear that up to the present time authorities have not been able to determine the values of these operations, but from various writings it would seem that their value is not great, and that for a few successes there are many failures. Some of the procedures would, on general principles, seem quite useless. The operation for uniting the ends of nerves by cutting flaps has been condemned as useless, but that this method is sometimes followed by success is illustrated by the following case :—

Case 5.—Gunshot wound of left forearm. Compound fracture of left radius. Injury to the ulnar nerve, June, 1915. Operation August, 1915. Exploration of the ulnar nerve and suture by means of turned-down flap from the upper end of the nerve to bridge a gap between the divided end. Recovery.

Lance-Cpl. B. B. was admitted to the Norfolk War Hospital in June, 1915. On examination of the left upper extremity he was found to be

suffering from a compound fracture of the left radius, together with an injury to the ulnar nerve.

The wound healed well, but there was no improvement in the condition of the parts supplied by the ulnar nerve. On August 30, 1915, an operation was performed. The ulnar nerve was exposed in the forearm. It was found to have been completely divided, and a large segment of the nerve had been completely destroyed. When the divided ends had been dissected free they could not be brought together. A flap was turned down from the upper end of the nerve in order to bridge the gap; union was then made with very fine silk. Slow improvement followed the operation. The patient had been seen on several occasions since the operation. He was examined in February, 1918, two and a half years after the operation. There was some return of sensation in the area of distribution of the ulnar nerve. There were slight contractions of the third and fourth fingers, but the hand was an extremely good one. He was still in the Army, and expected to be passed fit for general service at the next Medical Board.

Under certain circumstances nerve suture may be replaced by tendon transplantation, namely: (1) When nerve suture is impossible; (2) when the functional result attained by nerve suture is unsatisfactory. The most favourable cases in which to prepare tendon transplantation are those of injury to the musculo-spiral and posterior interosseous nerves. The transplantation of the tendon of the flexor carpi radialis through and into the tendons of the extensor longus pollicis, the extensor brevis pollicis, and the extensors of the fingers is an operation followed by such good results that it should always be done in cases when it is considered likely that the musculo-spiral nerve will not recover. "Complete restoration of function may be expected in four weeks, an enormous saving of time compared with the year which must elapse before recovery after nerve suture."—(Murphy).

Prognosis and Results.—The prognosis depends upon the variety and severity of the injury and the complications present. Cases of physiological division usually do well, and often recover completely in from three to six months. Cases of compression require prolonged and skilful treatment if they are to do well, recovery is often incomplete, but good results are often obtained, and the disability usually is not great. The prognosis in cases of complete division is always grave, especially if complications are present. Great patience is required in the treatment of these cases. It is doubtful if complete and perfect recovery ever results from a divided nerve, but that much can be done to produce good functional results is undoubted. The time taken for recovery is often long and progress slow, but some cases continue to improve for two or three years after the operation of suture of the nerve has been skilfully performed. It is difficult to follow up cases for a long period of time. A few cases in this series have been observed for as long as two and a half years, the results have been grati-

fying in these cases which have been observed for a long period. The average duration of observation after the operation has been over eight months. This is too short a time to obtain the final results, but it is long enough to form some estimate as to what they are likely to be.

In attempting to sum up the results a careful record has been taken of the patients' condition on their discharge from hospital. Letters have been sent to the patients, and questions have been asked with regard to their progress and present condition. Many replies have been received. An attempt has been made to classify the results into one of the following groups :—

(1) Perfect recovery ; (2) very good recovery ; (3) good recovery ; (4) moderate recovery ; (5) bad recovery : (6) very bad recovery. Opinions, no doubt, would differ as to which ought to be considered a good and which a bad result; the patient's opinion with regard to the result has been allowed to have full weight, and the severity of the primary lesion has also been taken into consideration. No case of (1) "perfect recovery" has been obtained. If the patient can follow any occupation and has little disability the result has been considered to be (2) "very good." The result has been considered to be (3) "good" if the patient has been retained in the Army and classified into a group, or has showed signs of commencing recovery within six months from the date of operation. (4) "Moderate" results are those in which the limb is considered to be much better than an artificial one, but the disability is nevertheless considerable. (5) "Bad" results are those in which the limb is of very little use, but is still as good or better than an artificial limb. (6) "Very bad" results are those in which the limb is practically useless, and are the cases in which amputation must be considered.

Tables have been drawn up showing the number of cases operated upon. The various nerve lesions have been classified in a tabular form, and an attempt made to show the results obtained up to the present time. From a study of these cases the following are the conclusions arrived at:—

(1) That the diagnosis of an injury to a peripheral nerve ought to be made at the earliest possible time.

(2) Successful recovery depends upon early, correct, and continuous treatment.

(3) Primary suture should be considered and practised whenever possible.

(4) That there should be no unnecessary delay in exploring a nerve if there is sufficient evidence that it has received some injury resulting in a macroscopic pathological lesion.

(5) It is almost certain that some macroscopical lesion is present in cases which show no signs of recovery after four months' treatment.

(6) That operations on injured nerves should only be done in well-

COMPLETE LESION OF THE ULNAR NERVE. OPERATION REQUIRED: END-TO-END SUTURE.

No. of case	Name	Length of time between reception of wound and operation	Period of observation since operation	Complications	Presence of muscular wasting	Presence of return of sensation	Presence of muscular contraction	Presence of trophic lesion (ulceration)	Result considered to be	Remarks
1	A. S. ..	6 months	12 months	—	—	—	—	—	Good ..	Returned to duty. Killed
2	E. J. ..	5 ,,	18 ,,	—	Yes ..	No ..	Yes ..	No ..	Bad ..	—
3	F. H. ..	2 ,,	18 ,,	—	,, ..	,, ..	Slight ..	,, ..	Moderate..	Electrician's labourer
4	A. D. ..	3 ,,	9 ,,	—	Slight ..	Yes ..	No ..	,, ..	Good ..	Sensation and power returning at end of eight months. A very good hand
5	J. R. ..	3 ,,	6 ,,	—	,, ..	No ..	Slight ..	,, ..	Moderate..	—
6	J. H. ..	12 ,,	14 ,,	—	Yes ..	,, ..	Yes ..	,, ..	,, ..	—
7	A. W. ..	3 ,,	14 ,,	—	,, ..	,, ..	No ..	,, ..	,, ..	Can do light work
8	A. S. ..	4 ,,	12 ,,	—	,, ..	,, ..	Yes ..	,, ..	,, ..	—
9	A. D. ..	11 ,,	8 ,,	—	Slight ..	Yes ..	Slight ..	,, ..	Good ..	Work—fixing woodwork
10	E. J. ..	3 ,,	12 ,,	—	,, ..	No ..	No ..	,, ..	Bad ..	—
11	J. G. ..	2 ,,	9 ,,	Fractured ulna	,, ..	Slight ..	Slight ..	,, ..	Moderate..	—
12	T. E. R.	3 ,,	9 ,,	—	,, ..	Yes; slight	,, ..	,, ..	,, ..	Passed B 2
13	F. J. ..	3 ,,	6 ,,	—	,, ..	No ..	,, ..	,, ..	Good ..	—
14	H. C. J.	4 ,,	9 ,,	Fractured radius	,, ..	,, ..	,, ..	,, ..	,, ..	—
15	A. M. D.	7 ,,	8 ,,	Fractured metacarpal	Yes ..	,, ..	Yes ..	,, ..	Bad ..	—
16	E. R. ..	5 ,,	8 ,,	—	,, ..	,, ..	,, ..	,, ..	Good ..	—
17	H. K. ..	3 ,,	7 ,,	—	Slight ..	Slight ..	No ..	,, ..	,, ..	—
18	J. C. ..	5 ,,	7 ,,	—	,, ..	No ..	Slight ..	,, ..	,, ..	—
19	S. M. ..	3 ,,	6 ,,	—	,, ..	,, ..	,, ..	,, ..	,, ..	—
20	W. M. ..	7 ,,	7 ,,	—	Yes ..	,, ..	Yes ..	,, ..	Very bad ..	—
21	S. M. ..	6 ,,	6 ,,	—	,, ..	,, ..	,, ..	,, ..	Good ..	—
22	H. L. ..	6 ,,	5 ,,	Fractured ulna	,, ..	,, ..	,, ..	,, ..	Moderate..	—

COMPLETE LESION OF THE ULNAR NERVE. SUTURE BY FLAP METHOD.

23	L. B. ..	3 months	30 months	Fractured radius	Slight ..	Yes ..	Slight ..	No ..	Very good	—

Lesions of the Ulnar Nerve. Cases of Compression, etc.

1	C. E. ..	6 months	24 months	Fractured ulna	Slight ..	Slight ..	Yes ..	No ..	Moderate..	—
2	S. A. ..	4 ,,	24 ,,	Fractured ulna	,, ..	No ..	Slight ..	,, ..	,, ..	—
3	C. C. ..	12 ,,	15 ,,	None ..	,, ..	,, ..	,, ..	,, ..	Good ..	A very useful hand.
4	A. C. ..	3 ,,	15 ,,	,, ..	,, ..	Slight ..	No ..	,, ..	Moderate..	Fingers rather stiff.
5	F. B. ..	3 ,,	6 ,,	,, ..	,, ..	No ..	,, ..	,, ..	Good ..	Hand weak but improving.
6	C. W. ..	6 ,,	4 ,,	,, ..	,, ..	,, ..	Slight ..	,, ..	,, ..	—
7	S. P. ..	3 ,,	18 ,,	Fractured radius	Yes ..	Slight ..	No ..	,, ..	,, ..	—
8	S. R. ..	1 month	4 ,,	—	—	—	—	—	—	Satisfactory result on discharge from hospital. Cannot be traced.
9	R. L. ..	2 months	4 ,,	—	—	—	—	—	—	Ditto. Ditto.
10	J. C. ..	3 ,,	4 ,,	—	Slight ..	No ..	No ..	,, ..	Moderate..	—
11	C. C. ..	2 ,,	4 ,,	—	,, ..	,, ..	,, ..	,, ..	,, ..	—
12	R. T. ..	2 ,,	12 ,,	—	,, ..	Yes ..	,, ..	,, ..	Good ..	—

Lesions of the Median Nerve. Cases of Division—Suture.

1	G. C. K.	8 ,,	12 months	Fractured radius	Yes ..	Slight ..	No ..	Yes ..	Good ..	A very useful hand on discharge from hospital.
2	S. S. ..	1 month	6 ,,	None ..	No ..	Yes ..	,, ..	No ..	,, ..	—
3	S. W. ..	3 months	9 ,,	,, ..	,, ..	,, ..	,, ..	,, ..	,, ..	—
4	C. B. ..	3 ,,	9 ,,	,, ..	,, ..	Slight ..	,, ..	,, ..	,, ..	—
5	J. W. ..	2 ,,	6 ,,	,, ..	Slight ..	No ..	,, ..	,, ..	Moderate..	Improving.
6	S. W. ..	3 ,,	4 ,,	,, ..	,, ..	,, ..	,, ..	,, ..	,, ..	,,
7	H. H. ..	14 ,,	10 ,,	Severe injury to tendons	Yes ..	,, ..	Yes ..	,, ..	Bad ..	—

Lesions of the Median Nerve—Cases of Compression, etc.

1	P. H. ..	1 month	2 months	None ..	No ..	Yes ..	No ..	No ..	Good ..	—
2	C. G. ..	2 months	12 ,,	,, ..	,, ..	,, ..	,, ..	,, ..	,, ..	—
3	J. J. ..	5 ,,	6 ,,	,, ..	,, ..	No ..	Yes ..	,, ..	Moderate..	—
4	F. S. ..	5 ,,	4 ,,	Aneurysm of brachial artery; injury to elbow joint	,, ..	,, ..	,, ..	Yes ..	,, ..	—
5	F. S. ..	6 ,,	5 ,,	None ..	Yes ..	,, ..	,, ..	No ..	,, ..	—
6	J. B. ..	4 ,,	5 ,,	,, ..	No ..	Yes ..	No ..	,, ..	Good ..	—
7	W. J. ..	14 ,,	4 ,,	Fractured humerus	Yes ..	No ..	,, ..	,, ..	Moderate..	—

LESION OF MUSCULO-SPIRAL NERVE. CASES OF DIVISION. OPERATION, SUTURE.

No. of case	Name	Length of time between reception of wound and operation	Length of time of observation after operation	Complications	Presence of muscular wasting	Presence of drop wrist	Presence of muscular contraction	Result considered to be	Remarks
1	J. H. ..	4 months	14 months	Secondary hæmorrhage from superior profunda artery	Yes ..	Recovered	No ..	Good ..	Hand still weak
2	J. R. ..	3 ,,	12 ,,	None	Slight ..	,,	,, ..	,, ..	Extensors still weak
3	R. T. ..	5 ,,	6 ,,	Fractured humerus ..	,, ..	Recovering	,, ..	Moderate..	—
4	J. W. ..	2 ,,	4 ,,	—	Yes ..	Yes ..	,, ..	—	Good condition on leaving hospital. Unable to trace
5	P. S. ..	8 ,,	8 ,,	Fractured humerus ..	,, ..	,, ..	,, ..	Moderate..	—
6	W. L. ..	2 ,,	6 ,,	—	Slight ..	Recovering	,, ..	Good ..	—
7	F. F. ..	4 ,,	10 ,,	Fractured humerus ..	Yes ..	Yes ..	,, ..	Moderate..	—
8	M. M. ..	4 ,,	8 ,,	,, ,, ..	,, ..	,, ..	,, ..	,, ..	—

LESION OF THE MUSCOLO-SPIRAL NERVE. CASES OF COMPRESSION, ETC.

1	B. B. ..	2 weeks..	4 months	—	Slight ..	Recovered	No ..	Good ..	—
2	F. W. ..	3 months	6 ,,	—	,, ..	,,	,, ..	,, ..	—
3	F. J. ..	2 ,,	6 ,,	—	,, ..	,,	,, ..	,, ..	—
4	P. C. ..	4 ,,	4 ,,	—	—	—	—	—	Fair condition on leaving hospital. Not able to trace
5	A. C. ..	6 ,,	6 ,,	Fractured humerus ..	Yes ..	Recovered	No ..	Good ..	—
6	F. S. ..	3 ,,	9 ,,	,, ,, ..	,, ..	Yes ..	,, ..	Moderate..	—
7	T. W. ..	4 ,,	4 ,,	Fractured humerus; slight extensor tendons	,, ..	,, ..	,, ..	Bad ..	—
8	M. C. ..	5 ,,	4 ,,	Fractured humerus ..	—	—	—	—	Fair condition on leaving hospital. Not able to trace.
9	B. B. ..	8 ,,	8 ,,	,, ,, ..	Yes ..	Recovered	No ..	Moderate..	—

Complete Lesion of the External Popliteal Nerve. Operation: Suture.

No. of case	Name	Length of time between reception of wound and operation	Length of time of observation after operation	Complications	Presence of muscular wasting	Presence of return of sensation	Presence of muscular contraction	Recovery from drop-foot	Result considered to be	Remarks
1	B. B. ..	14 months	8 months	None	Slight ..	No ..	No ..	No ..	Moderate..	—
2	G. N. ..	3 ,, ..	6 ,, ..	,, ...	,, ..	,, ..	,, ..	,, ..	,, ..	—

Lesion of the External Popliteal Nerve. Cases of Compression, etc.

1	P. C. ..	3 months	15 months	None	None ..	Yes ..	No ..	Yes ..	Very good	Returned to active service.
2	T. G. N.	5 ,, ..	6 ,, ..	,, ...	Slight ..	,, ..	,, ..	,, ..	Good ..	—
3	E. W. ..	3 ,, ..	8 ,, ..	,, ...	None ..	No ..	,, ..	,, ..	,, ..	—
4	D. S. S.	7 ,, ..	6 ,, ..	Severe flesh wound	Yes ..	,, ..	Slight ..	No ..	Moderate..	—

Complete Lesion of the Ulnar and Median Nerves. Operation: End-to-end Suture.

No. of case	Name	Length of time between reception of wound and operation	Period of observation since operation	Complications	Presence of muscular wasting	Presence of return of sensation	Presence of muscular contraction	Presence of trophic lesion (muscular)	Result to be considered
1	N. C.	12 months ..	12 months ..	Severe flesh wound	Yes ..	No ..	Yes ..	No ..	Bad
2	C. H.	4 ,, ..	16 ,, ..	None	,, ..	,, ..	,, ..	,,	,,
3	B. B.	6 ,, ..	8 ,, ..	—	,, ..	Slight ..	No ..	Yes; recovering	Good

Incomplete Lesions of the Ulnar and Median Nerves. Compression.

	H. R.	4 months ..	6 months ..	None	Yes ..	No ..	Slight ..	No ..	Moderate

Miscellaneous Lesions.

1	Nerve Lesions L. I. Division of post-tibial	8 months ..	14 months ..	None	Yes ..	Slight ..	Slight ..	No ..	Moderate
2	L. J. Division of sciatic	6 ,, ..	15 ,, ..	Very severe flesh wound ..	,, ..	,, ..	No ..	,, ..	Good
3	G. G. Internal popliteal caught in scar tissues	2 ,, ..	9 ,, ..	—	No ..	Yes ..	,, ..	,, ..	,,

TABLE OF RESULTS OF LESION OF THE ULNAR AND MEDIAN, MUSCULO-SPIRAL, AND EXTERNAL POPLITEAL NERVES.

Results	Ulnar		Median		Musculo-spiral		External popliteal		Combined lesions: median and ulnar		Total		Grand total
	Complete lesion	Incomplete lesion	Complete lesion	Incomplete lesion	Complete lesion	Incomplete lesion	Complete lesion	Incomplete lesion	Complete lesion	Incomplete lesion	Complete lesion	Incomplete lesion	
Perfect.. ..	—	—	—	—	—	—	—	—	—	—	0	0	0
Very good ..	1	—	—	—	—	—	—	1	—	—	1	1	2
Good	10	5	4	3	4	4	—	2	1	—	19	14	33
Moderate ..	8	5	2	4	4	2	2	1	—	1	16	13	29
Bad	3	—	1	—	—	1	—	—	2	—	6	1	7
Very bad ..	1	—	—	—	—	—	—	—	—	—	1	0	1
—	—	2	—	—	—	2	—	—	—	—	0	4	4
Total ..	23	12	7	7	8	9	2	4	3	1	—	—	76

equipped general hospitals, and by those surgeons who have ample experience of such cases.

(7) That sufficient attention is not usually paid to the early pre-operative and post-operative treatment in paralytic deformities, and shortened muscles are often the result of ignorance and neglect.

(8) That the extreme gravity of an injury to a peripheral nerve is not sufficiently realized by the general profession.

I wish to acknowledge my indebtedness and appreciation to Colonel T. H. Openshaw, Consulting Surgeon to the Eastern Command, for his advice in some of the more difficult cases, and I also desire to thank Major Cleveland and his staff in the electro-therapeutic department of the hospital for numerous suggestions in the treatment of the cases.

The following table shows the total number of nerve lesions which have come under observation, and their relative frequency.

Ulnar	89
Median	51
Musculo-spiral and post-interosseous	50
External popliteal	30
Lesions of the brachial plexes	9
Combined lesions to the median and ulnar	8
Anterior tibial	4
Circumflex	2
Internal popliteal	2
Posterior tibial	2
Sciatic	2
Anterior crunal	1
	250

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THE PROPHYLAXIS OF MALARIA.

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PART I.

By Colonel G. T. RAWNSLEY.

In the *Practitioner* for the month of October, 1917, the interesting statement appears that Mitzmain[1] has carried out an important investigation for the United States Public Health Service on the problem whether the mosquito or man is the winter carrier of the malaria parasite. Amongst his conclusions are :—

(1) Only the adult female mosquito of anopheles hibernates.

(2) Anophelines were found negative for malarial parasites in winter.

(3) Man was largely infected with the malaria parasite and about one-fourth (24·8 per cent) of the human carriers harboured gametocytes.

(4) Three infected *Anopheles quadrimaculatus* were found in the houses of gametocyte carriers during May 15 to 26; previously thereto 1,180 specimens were negative.

The conclusion was thus arrived at that man is the sole winter carrier.

So far no other forms of animal life, except man and the anopheline mosquito, have been found by investigators to be carriers of the malaria parasite.

If we admit the accuracy of these statements, the lines indicated for the prophylaxis of malaria resolve themselves into the destruction of the parasite in man and the destruction of the female anopheline mosquito which alone with man is a harbourer of the malarial parasite.

It would appear therefore the best way to attain this end, as far as man is concerned, is by carrying out the necessary treatment, in a country where there is a malarial and a non-malarial season, in the winter months. The reasons which lend support to this view are :—

(1) There is a smaller incidence of malaria, primary cases being absent.

(2) Reinfections are non-existent owing to inactivity of the mosquito.

(3) If the major part of the population can be freed from the parasite, when the next malarial season starts fewer carriers of infection are present. If the treatment is begun sufficiently early relapses will indicate

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[1] Mitzmain. Public Health *Bulletin*, No. 84, 1916 (Treasury Department, U.S.A. Public Health Service).

who are carriers and who are not, and it should be easy in an army to remove those who are a source of danger by sending them out of the country before the onset of the summer and the period of renewed mosquito activity.

The prophylactic measures adopted in this army were as follows :—

(1) *In 1916 :—*

(*a*) Prophylactic quinine was given in five-grain doses twice weekly, usually on two consecutive days. It was quite useless to prevent a very high occurrence of malarial fever.

(*b*) Pieces of netting about one yard square were used to cover the face, but not being mosquito-proof were naturally ineffectual. Subsequently the size was increased to six feet by four feet, and in places where they could be used hospital pattern nets were issued.

(2) *In 1917 :—*

(*a*) Prophylactic quinine has been given in varying doses : ten grains twice weekly on Thursdays and Sundays, every other day, four days weekly and every day. In fifteen-grain doses daily and in twenty-grain doses daily. These doses have all failed to confer prophylaxis, in fact, I look upon the larger doses as positively dangerous. The smaller dose probably does not as a rule check pyrexia, and so the man reports sick for fever, his disease is recognized and he comes early under effective treatment ; but the larger amounts, that is a dosage of over and above ten grains twice weekly, have in my experience in a very large number of cases fulfilled the anti-pyretic action of the drug without destroying the malarial parasite. In many regiments treated in this way we were lulled into a sense of false security by the absence of pyrexia and later on many men who had never reported sick were found with enlarged spleens, anæmia, palpitation and all the symptoms of malarial cachexia. Thus by these methods the men became a source of danger in spreading infection, and the quinine instead of having a prophylactic effect had exactly the opposite, as it failed to destroy the parasite, and so the man became a gametocyte carrier capable of infecting mosquitoes. Many of the units treated with doses of quinine over ten grains twice weekly were the worst sufferers from malaria this year. I do not consider such doses have any effect on making the parasite quinine-resistant, but my experience is that the strength of the quinine solution in the blood is not sufficient in the doses aforementioned to destroy the parasite. Later on in this paper I shall give further reasons for this opinion.

(*b*) A bivouac mosquito net was used. This certainly afforded large protection and was an undoubted factor in the prevention of malaria. An improved type is being adopted for 1918.

(*c*) Head net veils and gloves for men on night duty. These were not popular ; men complained of difficulty in seeing and of handling their arms and in many cases they were discarded.

(*d*) Repellant ointment is undoubtedly useful if it is replaced very frequently during the hours men are exposed on night duty.

(*e*) Other anti-malarial measures having for their object the destruction of the mosquito.

In 1916, owing to the advanced state of the season, when we took over our present front little was done in this respect, but this year extensive drainage, canalization, oiling, clearing of brushwood, scrub and rank vegetation and burning of grass, etc., in the vicinity of camps, have been carried out with undoubtedly good results.

(*f*) Pitching camps on as high ground as possible and away from known malarial sites.

The result of these methods is shown by a comparison of the average daily sick rates for all causes per month as under for the same two Divisions. Malaria practically only affects these rates :—

	1916	1917
May	0·20	0·24
June	0·31	0·28
July	0·58	0·50
August	0·46	0·42
September	0·75	0·55
October	0·47	0·54
November	0·25	0·34

The slightly higher rates for October and November, 1917, are due to the fact that in 1916 all malarial cases were evacuated from the country, whereas in 1917 they have been treated here, therefore these rates include a higher proportion of relapses. But satisfactory as these results are it appeared to me that more might be done, and with this end in view I considered the advisability of putting troops on a much higher dose of daily quinine, viz., thirty grains daily. Captain D. Thomson, R.A.M.C., in his paper in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS stated this should be given in hospital, keeping the man in bed the first week, up in the ward the second week, and taking gentle exercise out of doors during the third week. But hospital treatment except for men with high temperatures or otherwise needing admission would not be feasible in the case of large numbers of men suffering from chronic malaria in an army in the field. I therefore received permission to start a small camp for 100 men; these men were under ordinary conditions except that they performed no large amount of work. They went for walks and did all the fatigues of their camp. The treatment given was thirty grains of quinine in mixture daily as follows :—

℞	Quinine sulphas	10 gr.	or,	Quinine bihydrochlor. ..	10 gr.
	Aquæ	ad 1 oz.		Acid hydrochlor. dil. ..	q.s.
	Acid sulph. dil.	q.s.		Aquæ	ad 1 oz.

Thrice daily, further well diluted with water, within five minutes of each meal, i.e., breakfast, dinner and tea. An iron, arsenic and quinine tabloid was also given at the same time, the composition of which is :—

℞	Iron hypophosphite	2 gr.
	Acid, arsenious, B.P.	$\frac{1}{50}$,,
	Quinine bisulphate	1 ,,
	Strychnine sulphate	$\frac{1}{30}$,,
	Saccharine, B.P.	$\frac{1}{100}$,,

The clinical results were rapid and exceeded all expectations, there were no untoward symptoms, such as deafness, altered vision, etc., and from the rapid disappearance of anæmia and the healthy colour which appeared in its place, it was easy to pick out new arrivals from those who had been some few days in camp. Even after five days the improvement was marked.

Being satisfied with the success of this treatment and that it had no ill effects on the men, it was resolved to continue treatment in other cases and under different conditions; in the one instance fifty-one men who were known to be badly infected with malaria were camped near a casualty clearing station and kept as nearly as possible under service conditions, doing route marches and fatigues, and about the same amount of work as they would have done in the front line. They lived in bivouac tents with mosquito nets, and during a great part of their stay the weather was very variable, being wet with cold winds, conditions which should have been favourable to chill and consequent malarial relapse. While here advantage was taken of the proximity of a Bacteriological Laboratory and an Ophthalmic Centre, for the purpose of carrying out observations appertaining to the state of the blood and the condition of their eyes.

Two medical officers, Captain W. H. Peacock, R.A.M.C., and Captain T. H. Comerford, R.A.M.C., gave most valuable assistance in closely watching and supervising the progress of treatment. No unfavourable symptoms were observed in any of these men by either of these officers, nor by myself as the result of frequent inspections. No defects of vision or hearing were observed. Anæmia soon vanished, the hæmoglobin rose in the blood and parasites disappeared microscopically, the spleen went down in size and the men became robust, vigorous and active. Nearly all the men increased largely in weight and previous results were confirmed. These fifty-one men were given no quinine for first few days of their stay at the casualty clearing station before treatment was commenced and fifteen of the number suffered from relapses of malarial fever and in many the parasite was found in their blood during this time. They took bihydrochloride of quinine.

In the other instance a company of a battalion was placed, at my request, on the same treatment by Lieutenant-Colonel R. A. Cunningham, R.A.M.C., whose report is added (Part II). This company remained doing full duty in the trenches, and subsequently, at the expiration of their tour there, in the support line. They took the treatment as will be seen without any unfavourable symptoms, but on the contrary with marked and beneficial results.

Two men out of the original fifty-one of the first observation had to remain on under treatment; one man still had the malignant parasite in his blood, but after a further period of treatment this had disappeared microscopically; the other man was suffering from an irregular atypical pyrexia, no parasite being found in his blood, but on the cessation of quinine

the malignant parasite was found in moderate numbers. No other man out of this number nor amongst the cases of the second observation treated by Lieutenant-Colonel Cunningham has so far had a relapse.

Allusion may now be made to the opinion previously expressed that smaller doses of quinine up to twenty grains do not make the parasite quinine-resistant. The result of the treatment of thirty-grain doses daily was followed by immediate, very rapid and marked improvement in men well dosed the whole season with quinine; the blood tests showed by the early disappearance of the parasite and the rapid rise in the hæmoglobin that no powers of quinine resistance had been conferred on the parasite when sufficient and effective doses of the drug were given, and one would not have expected to attain these results so speedily had such been the case, and the credit must be given to the production of such alterations in the blood to the activity of the drug.

The course of treatment recommended and which will be further observed is to put a company of a regiment at a time on thirty grains quinine daily for a period of twenty-four days. Men after four weeks begin to suffer from quinine intolerance.

Points to bear in mind are that the mixture should be well diluted in at least an ounce and a half of water, and administered *immediately* after a meal—the longer interval that elapses the more chance there is of intolerance to the drug. It should be given twice daily in fifteen-grain doses morning and evening; three minims of liquor arsenicalis hydrochloricus may be added to each dose, but Fowler's solution should not be used, as this preparation in an acid solution is liable to deposit the arsenic to the bottem of the bottle and a dangerous dose of arsenic may thus be given. The tablet of iron, arsenic and quinine is also a useful adjunct to treatment in place of the liquor arsenicalis hydrochloricus in the mixture. Another precaution is that the solution should be measured in a dispensing measure-glass, and tablespoons and other such measures not employed, as inaccuracy in dosage is bound to occur.

It has been found by Lieutenant-Colonel Cunningham, R.A.M.C., that healthy men stand this dosage as well as, if not better than, those suffering from malaria, and also in a further observation on my part; consequently the conclusion arrived at is that in very unhealthy portions of a line troops should only remain twelve days at the most and during this period should receive a daily dosage of thirty grains of quinine; this idea will be further developed during the next malarial season. Further, from a result of experience of two malarial seasons in Macedonia, my experience in West Africa, India and the West Indies is enhanced that:—

(1) Prophylactic quinine as now given is useless if not dangerous in the prevention of malaria, as it so frequently only masks the disease.

(2) That the proper prophylactic dose is one of thirty grains daily, but this cannot be given for a longer period than four weeks.

(3) That a smaller dosage of quinine does not render the parasite quinine-resistant.

(4) Prophylaxis should aim chiefly at destroying the mosquito and its larvæ, and protecting man from its bites, and when man becomes infected destroying the parasite by suitable doses of quinine, especially during the post-malarial season.

In the case of troops every officer and man who has been exposed to malarial infection should undergo a winter prophylactic course. In this connexion Colonel Sir M. P. C. Holt recently told me he had the blood examined of many men in this country with no record of malarial fever and found many of them infected with the parasite.

(5) The destruction of hibernating mosquitoes. The experience here so far is that only the female hibernates.

(6) Larvæ have also been found in the winter in Macedonia beneath the ice. Measures therefore for their destruction must also be taken.

Observations as to the effect of thirty grains of quinine daily on the blood of healthy men have also been made by Captain J. Warnock, R.A.M.C., and are included in his Report (Part III).

I am indebted to Captain H. E. Smith, R.A.M.C.(T)., for the following report on the condition of the eyes and the state of vision of the fifty-one men under observation at the casualty clearing station :—

"I have concluded the ophthalmic examination of the fifty-one post-malarial cases under special quinine treatment at the casualty clearing station. The cases were examined during the first and last weeks of the treatment, and the points investigated were :—

"(1) The visual acuity.

"(2) The white and colour fields.

"(3) Subjective symptoms, e.g., transient obscuration of vision.

"(4) Ophthalmoscopic examination : (*a*) colour of optic disc ; (*b*) size of vessels ; (*c*) any other abnormality.

"I have to report that there was no complaint of defective sight, no objective deterioration of visual acuity, and no evidence of change in the field or fundus in any of the cases."

One half of the men who had been treated both at the casualty clearing station and by Lieutenant-Colonel Cunningham have continued quinine in fifteen-grain doses daily, the other half have had no quinine.

The men from the casualty clearing station, with two exceptions, returned to duty with their regiments on November 15, 1917, four weeks ago. A few days before leaving, a team of eleven of these men played the casualty clearing station at football and won their match by 7 goals to 2 ; they played with vigour and showed no signs of distress during the game.

PART II.

By Lieutenant-Colonel R. A. CUNNINGHAM, R.A.M.C.

Malaria is an infective disease which is spread from one man to another by means of anopheline mosquitoes. Reducing the number of infected persons in a community is one of the methods of lowering the incidence of the disease. Owing to the absence of the civil population, infection in the front line area is chiefly derived from the troops themselves. If, therefore, it were possible to make a large proportion of the troops non-infective before the next malarial season begins, it would greatly assist in reducing the incidence of malaria.

With this object in view, Colonel G. T. Rawnsley, D.D.M.S., of the Corps, undertook a series of observations as to the effect of the administration of thirty grains of quinine daily for a period of from three to four weeks in permanently curing the disease, and so preventing the formation of carriers. If this treatment was to be applied as a practical measure to the whole Corps, it was necessary to prove that it could be carried out whilst the men were actually engaged in their ordinary duties with their units. At his request, therefore, I carried out a course of treatment in "X" Company, the most highly infected company in a badly infected battalion. Almost every man in the company had had malaria, and as it was impossible to say which men were or were not liable to relapses, all the men in the company who were present on October 10, 1917, with one or two exceptions, were put on the treatment. Each man received 30 grains quinine daily, 15 grains quinine sulph. in solution diluted to 1½ ounces being given every morning and evening after meals. During the second week two minims Fowler's solution were given with each dose, and during the fourth week three minims. As new drafts joined the company from hospital or elsewhere, they were also put on this treatment. The total number of men who received this treatment between October 10 and November 6 for at least three weeks was 104; of these eighty-eight received it for the full four weeks.

The following figures show the results of treatment:—

(1) Total number of men who had the treatment for at least three weeks 104

(2) Number of men who were sent to the Field Ambulance with fever between October 10 and November 6, whilst taking 30 grains quinine daily 2
These two men were sent to the Field Ambulance within the first few days after the treatment began.

(3) Number of men who were sent to the Field Ambulance with fever from the rest of the battalion (numbering about 500), between October 10 and November 6.. 80
The whole of these men had been on 10 grains daily for the last three months.

In addition to the men sent to hospital during this period, October 10 to November 6, a large number of men in the rest of the battalion had mild relapses, and were treated regimentally. Among the 104 men receiving the special treatment, only six had slight rises of temperature, and this was at the very beginning of the treatment. Three officers of

"X" Company who were not on the treatment had fever between October 10 and November 6.

From October 10 to 25 the men receiving the special treatment were in the front line, and were doing the ordinary work of the battalion—some digging, some on outpost, some wiring, etc. Two platoons were in a fort in the front line from October 14 to 25, and during this period no man in these two platoons had fever or was off duty, although each man was on outpost duty every other night, and the weather was frequently wet and cold.

On October 25 the company moved back to a camp in support, and although the day had been very wet, and the men had to bivouac on wet ground when they got to camp, no one took fever in consequence.

The men have improved very much in appearance and health, and have lost the anæmic look that they had. They are at present doing training, road making, route marching, etc., and play football with much vigour after the day's work. Many of them also took part in the regimental sports—running, jumping, tug-of-war, etc. They went back again into the front line on November 7.

During the course of treatment I saw the quinine administered, inspected every man morning and evening, felt his pulse, and inquired how he was.

In a very few cases I reduced the dose to twenty grains on account of slight buzzing and slight deafness, but it was not really necessary to have done so. In one or two cases I gave men tabloids instead of solution on account of slight indigestion. Two of the men towards the end of the fourth week of treatment complained of slight giddiness, and I stopped their quinine. Apart from these few cases all the men took the quinine without the slightest inconvenience, including fourteen men who had never had malaria.

The following are some details of the previous history of the 104 men who received the treatment:—

(1) Number who had been in hospital with malaria	46
(2) Number who had had fever, but were treated regimentally	44
(3) Number who had never had fever	14
Total	104

Details as to relapses in the ninety men who had had fever:—

(1) Number who had had numerous relapses previous to the commencement of the special treatment	6
(2) Number who had had two relapses	6
(3) Number who had had one relapse	25
(4) Number who had had no relapse	53
Total	90

The observation is being continued as follows:—

The administration of quinine to the fourteen men who never had malaria has been stopped.

As regards the remaining 90, 2 men have gone away, which leaves 88.

The administration of quinine to 44 of these has been stopped. The other 44 are to receive 15 grains quinine daily for one month, and then 10 grains daily for another month.

The number of relapses which occur in the first forty-four will be compared with the number occurring in the second forty-four.

A roll of the men has been made, and any case of fever which occurs among them, whether treated regimentally or admitted to field ambulance, is notified.

During the month of November seventy-two cases of malaria and N.Y.D. pyrexia were admitted to field ambulance from the rest of the battalion, and none from the men who underwent the treatment. One of the men had a slight rise of temperature on November 30, and he is being treated regimentally.

These results are exceedingly striking. In eight weeks there was practically no pyrexia among the 104 men of "X" Company, although this was the worst infected company in the battalion, while from the rest of the battalion, during the same period, nearly 150 men were admitted to hospital with malaria and N.Y.D. (pyrexia), and numerous others were treated regimentally.

There is no reason to suppose that what happened in this company as the result of the treatment would not also approximately happen in a whole battalion, a whole division, or a whole corps, if the treatment were as thoroughly and carefully carried out; and I have no doubt that if this were done the number of relapses occurring in the spring months would be immensely reduced. A roll could be kept of the men who resisted the treatment and remained carriers, and they could either be sent out of the country or kept at the base, or on the lines of communication, where the presence of carriers is not of so much importance, as there is already an infected native population there. If this were done, it would greatly reduce the number of infected anophelines in the Corps areas, and consequently lessen the incidence of malaria.

PART III.

By Captain J. WARNOCK.

Royal Army Medical Corps.

O. i./c. Mobile Bacteriological Laboratory.

Laboratory Notes on Malaria with special Reference to the Treatment of a Series of Unselected Cases.

The series of cases considered was chosen under the direction of Colonel G. T. Rawnsley. Each man had a clear past history of clinical malaria, and was so selected as to be roughly a sample of the malarially affected troops.

The treatment adopted was a continuous twenty-eight days' quinine course of thirty grains daily combined with arsenic in small increasing doses.

The usual methods of investigation have been employed throughout, and conclusions drawn from the consideration of this special series as well as from the routine examination of the many thousand specimens which the material of this army has provided.

The points considered have been :—

(1) Continuous clinical records of temperature, pulse, weight, etc., among the fifty-one special cases.

(2) Untoward effects of quinine, if any, such as vomiting, giddiness, deafness, defects of vision, etc.

(3) Laboratory examinations directed to the condition of the blood and the study of the malarial parasite.

Control examinations were made in a number of "healthy" men chosen so far as could be determined from amongst those who had not had malaria and who had served only for a short period with this army.

As an introduction to the detailed account, some general observations may be made on the malarial question as it arises here.

(*a*) The whole natural picture of malaria has been necessarily clouded by the complication of quinine treatment.

(*b*) Malarial patients are often much more seriously debilitated, even after a few attacks, than the blood examination would suggest, and conversely the blood will often show an enormous number of cells invaded by the parasite with no corresponding clinical gravity of effect.

(*c*) All three classical types of malarial parasite have been found. The quartan parasite has been extremely rare but the benign and malignant tertian parasites have been universally prevalent and a seasonal variation has been strictly observed.

In the early months of the year, benign tertian alone was seen and gamete forms were relatively frequent; with the advance of summer however the gamete forms became less and less in evidence, but again increased in proportion with the commencement of the winter.

The malignant tertian parasite appeared about mid-July and increased in prevalence through the hotter months, declining in numbers with the autumn temperature, though still accounting for most of the severe cases until toward the end of November, when the benign parasite in "relapse cases" became again the common type.

It may be added that thick-and-thin film methods of examination have been employed, and that thin films have been found most generally useful, thick films being, however, the method of choice for the discovery of pigmented, more especially the crescent, forms.

(*d*) Quinine treatment and diagnosis. Malarial pyrexia is so generally reduced by moderate doses of quinine, e.g., thirty grains daily, that a temperature over 99° on the fourth day is a practical exclusion of malaria.

The response, or absence of response, to quinine treatment is therefore practically decisive from the point of view of diagnosis. This statement refers to the "ordinary case," and qualifications will be dealt with later.

(*e*) Quinine in moderate doses quickly banishes asexual parasites from the peripheral circulation, so that, often after one dose, and usually after three doses of ten grains, microscopic diagnosis becomes very tedious.

The gamete forms are not so influenced, but their numbers are not generally great.

Following these general statements some detailed figures may be given of the results of the inquiry into the effects of the combined quinine and arsenic treatment carried out under more or less active service conditions.

I.—*Clinical Records.*—These may be shortly summarized :—

(*a*) There was no difficulty with continuous administration of quinine, and no unpleasant effects noted beyond very slight vomiting, easily corrected, which occurred in a few cases in the fourth week of treatment.

(*b*) All the men looked better with two exceptions ; one case (malignant tertian) will be detailed later, and the other was under special vaccine treatment for boils.

(*c*) An average increase of weight of five pounds was recorded. In only five cases was a decrease noted ; two of these were the cases mentioned above, and the decline of the others (two pounds) was so slight as to be negligible.

(*d*) Cardiac response to exercise was much more healthy at the end of treatment than before.

II.—*Laboratory Examinations.*—Attention was directed to :—

(1) Discovery of the parasite and inquiry into its reaction to quinine medication.

(2) Hæmoglobin estimations.

(3) Counts of red and white blood cells.

(4) Differential counts of white cells.

(5) Inquiry into a possible fragility of the red cells of men undergoing quinine treatment and a possible hæmolytic action of the serum.

(1) The malarial parasite was discovered in nineteen out of the fifty-one cases (M.T. 6, B.T. 9, ? type 4) ; two of these cases were continuously apyrexial and two others only once reached 99°. In general, it may be stated that benign tertian parasites are not often found in the apyrexial period during the season of prophylactic quinine.

It has been determined, however, by a commission working under the direction of Lieutenant-Colonel L. B. Dudgeon, Consulting Bacteriologist to this army, that during the winter months a careful search will reveal the parasites in apyrexial "malarial carriers" in a considerable percentage of the cases.

In one of the fifty-one cases crescents were found up to fourteen days after commencement of quinine treatment ; such a discovery of crescent parasites after the period of treatment with thirty grains daily has been a common observation.

In a second case crescents, in small numbers, were demonstrated up to forty-six days' treatment.

In no case were asexual parasites found after three days' treatment.

The effect of quinine treatment in the pyrexia of malaria has already been referred to and a general diagnostic rule laid down.

Qualifications of this rule must be made, however, in the many severe cases of malignant tertian malaria which have been, throughout the autumn, far from uncommon.

Fever of four, five, or six days' duration, with occasional irregular slight rise of temperature afterwards, is a common occurrence as an almost typical eight days' chart of a "moderately severe" case here presented would show.

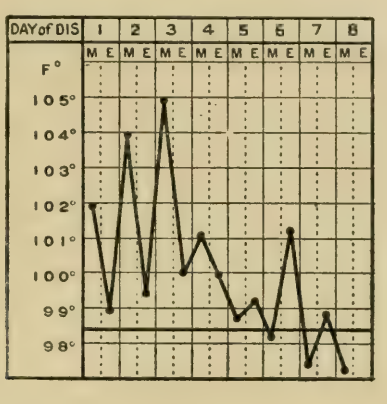


CHART 1.

In addition to these more usual types of case, rarer cases of more or less continued slight pyrexia occur on which quinine treatment would appear to have very little influence.

One such case occurred amongst the special series of post-malarial cases dealt with, and a chart with details is given. In this case no parasite was discovered, in spite of very many repeated examinations both at the beginning and during the progress of treatment.

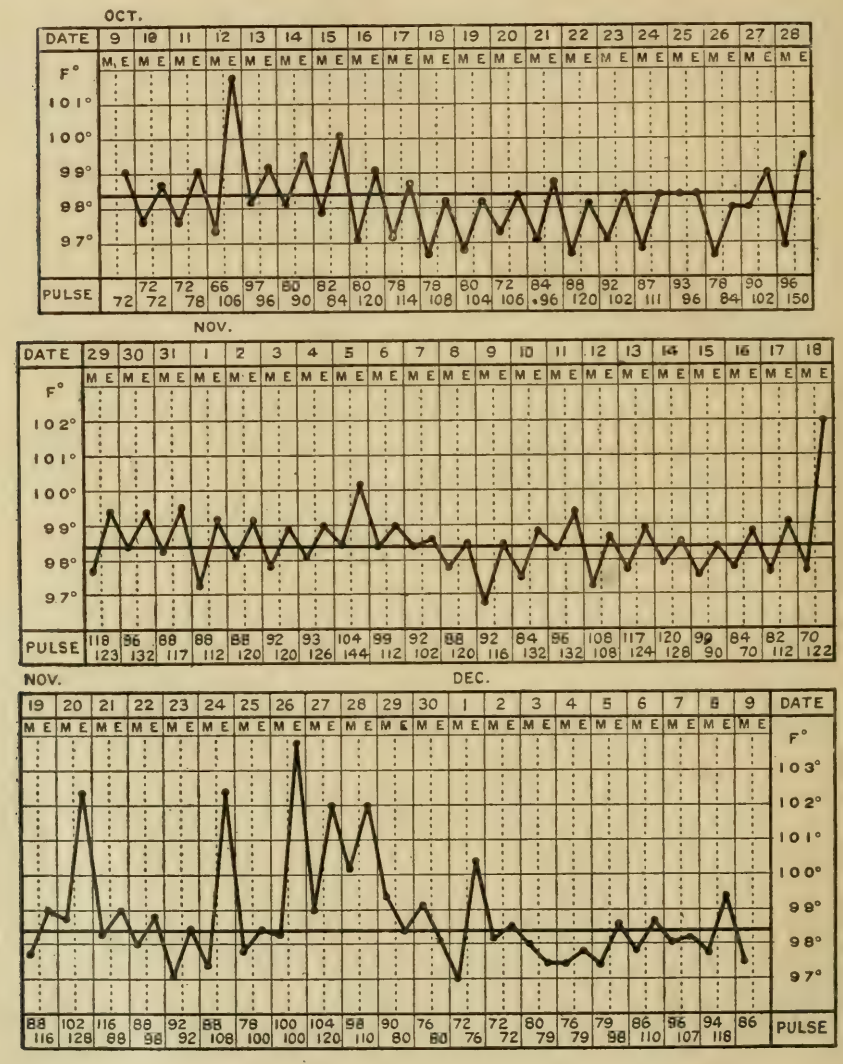
This negative consideration, and also the absence of a palpable spleen and the existence of a high leucocytic count (9,000 to 13,000), combined with the irregular pyrexia, led to the alternative suggestions of oral sepsis, enterica and tuberculosis, for all of which hypotheses diagnostic procedures were employed with negative results.

After six weeks' continuous treatment (thirty grains daily) quinine was abandoned and in five days numerous malignant tertian rings appeared in the peripheral circulation coincident with a "bilious" vomiting and a typical attack of malignant tertian fever. Quinine was then again resumed in larger doses (forty-five grains daily), the first dose being intramuscular owing to the vomiting; the condition, however, seems to have been more or less controlled, but not shortened by the treatment.

(2) Hæmoglobin estimates: Figures here are restricted to the small

series of fifty-one selected cases and the results have been extremely striking. A rapid rise in hæmoglobin value was immediately obvious, corresponding with the improved general appearance and physical fitness of the men.

CHART OF CASE 28.



The average increase was fourteen per cent at the end of treatment, but the closest grouping of figures approximated to 17·5 per cent, and this may be taken as what might be termed the "expectation of improvement."

Extreme cases of thirty per cent and forty per cent increase were recorded.

Comment may be made on the fact that most of the cases at first had hæmoglobin estimations of 70 to 75 per cent, while a series of normal men gave values 85 to 90 per cent.

This difference in oxygen-carrying capacity of the blood is not enough to account for the obvious physical unfitness affecting nearly the whole series examined and would suggest that the malarial organism produces its effects more by a general toxæmia than by a limited destruction of the red blood cells. That this is so is evident from the intense tissue destruction found post mortem in practically all the fatal cases, even when macroscopically, beyond enlargement in the spleen, there may be no obvious disease or cause of death.

(3) Red counts: In the special series considered, an increase parallel to the increase in hæmoglobin was observed. The average increase was fourteen per cent.

White cell counts: Observations were, for the sake of comparison, made always at the same time of the day, but owing to the known normal variations actual figures are of little value. Hence general conclusions may be given to which it was found that the small special series also conformed.

In the apyrexial period counts below 3,000 or above 9,000 are not common, while 4,000 to 6,000 would appear to be the general rule.

During an "attack," a more marked leucopenia is often found, but the exceptions are so common that this can scarcely be accepted as a rule; it would appear that very low counts only occur if there is marked anæmia, while if the attack is resistant or severe a high count is more likely to be found.

(4) Differential counts of white blood cells: These estimations again made over a large number of cases have given interesting results.

The figures may be best presented by considering definite illustrative series. Only three cell types for the moment are considered.

	Average percentage count of cells		
	Polymorphonuclear	Lymphocytes	Large hyalines
Series 1.			
Fifty cases of benign tertian fever during an attack and before commencement of quinine treatment	54	27	17
Series 2.			
Fifteen cases of malignant tertian, also during attack and before quinine	44	31	23
Series 3.			
Twenty-five cases of unverified malaria, during attack and before quinine	58	24	16
Series 4.			
Fifty cases of afrebrile "post-malaria" cases during treatment with quinine	45	34	19
Series 5.			
Fifteen cases where malaria could be practically excluded	48	42	10

Comment on these figures as regards the deviation from the normal is unnecessary, except for the inclusion of the last series, which was strictly chosen to exclude malaria but to include men who had served for at least one summer in this country.

It will at once appear that an increased percentage of large hyaline cells is of little diagnostic value in malaria; since a similar phenomenon appears to be produced by climatic or other causes amongst healthy troops serving with this force.

The numerical differences above detailed are not the only deviations from the normal, for not only is the total mononuclear count increased, but the type of cell differs widely from that found in health. Typical lymphocytes and large hyaline cells are found, but there are also present types not seen in normal blood, but occurring in the bone marrow and the spleen. Typical myelocytes are sometimes found and large finely granular mononuclear cells suggesting gradations between true myelocytes on the one hand and polynuclear cells and large hyaline leucocytes on the other. The number of these cells varies and appears to have some relation to the severity of the case. The actual number has not been noted above five per cent of the total white cell count.

A further malarial abnormality is the presence of the characteristic pigment in the large hyaline and polymorphonuclear cells. This occurrence has been looked for over a series of several thousand specimens, and while pigment in both types of cell has been occasionally seen the examples have been so extremely rare that the observation can have no value in the diagnostic sense. The conclusion, therefore, drawn from this method of inquiry has been that a microscopic diagnosis of malaria must, for all practical purposes, be based entirely on the discovery of the parasite.

(5) Inquiry into a possible quinine-induced fragility of red blood cells or hæmolytic action of the serum.

That quinine treatment may damage the red cells in ordinary cases and even under special circumstances predispose to, or cause, blackwater fever has been often stated. Barret and Yorke have proved that quinine in dilution approximating to that ordinarily present in the circulating blood after administration has no hæmolytic action on washed red cells.

Sampson and Edie have, in a short series of men and animals, determined the total excretion of urobilin and have hence deduced a probable hæmolytic power. Their series, however, has been so short and the results so varying, that any conclusions must be uncertain.

Our examinations have been limited to thirty cases. A small but almost constant difference has been found amounting to 0·025 per cent in the strength of saline which just produced hæmolysis, to this extent the series treated having less fragile cells than the series of "controls," and in the same sense the serum observations have discovered no hæmolytic action, the deviations from control figures in the few cases which occurred being in the direction of protection of the cells. The numbers, however,

so far examined have been too small from which to draw definite conclusions, beyond the fact that any untoward influence of quinine in the blood, if present, must be very slight, and is probably more than counterbalanced by the conjunction of arsenic.

Summary.

For the sake of clearness, conclusions may be summarized regarding the possibilities of the standard quinine treatment.

(1) No deafness, visual defects or other disadvantages are likely to accompany or follow the administration of quinine thirty grains daily for three to four weeks.

(2) The general health and physical fitness of malarial cases so treated will markedly improve under treatment.

(3) Arsenic is a valuable adjunct to quinine in the treatment of malaria.

(4) Few relapses are likely to occur and fresh infections can be dealt with as they arise (no relapse, excluding one uncured resistant case, occurred amongst the special series treated, after four weeks of very severe weather since cessation of the treatment).

(5) The malignant tertian parasite would appear to be the most resistant type. Relapse cases occurring in the early months of the year are generally benign tertian; it is probable, therefore, that a three to four weeks' course of thirty grains daily will cure a considerable proportion of the men so treated.

(6) A possible difference in the parasite found in this country from that seen elsewhere has been often mentioned. It would seem probable, however, that the different effects produced may be due to indefinite and irregular quinine administration.

(*To be continued.*)

Clinical and other Notes.

ANÆSTHETICS IN THE FIELD.

By Captain W. R. H. HEDDY.
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Late Assistant Anæsthetist (Resident) Middlesex Hospital.

Comparatively few surgical operations are now performed in the immediate vicinity of the firing-line, since it is the routine practice to evacuate cases requiring operative treatment to the casualty clearing station with all possible speed. There are, however, circumstances in which the administration of anæsthetics to patients in field ambulances may be indicated, and it is the purpose of this article to discuss briefly the conditions in which the employment of anæsthesia may be useful and to give a short account of the equipment available.

It well be well to deal initially with the question of equipment. The most important items of the anæsthetic outfit are contained in field surgical pannier No. 1, which includes among its contents chloroform (three pounds) in sealed glass tubes, two drop-bottles, a hypodermic case with the essential drugs, and an excellent saline infusion apparatus. Further supplies of chloroform (one pound) are to be found in field medical pannier No. 1, together with a spare drop-bottle and a reserve set of hypodermics. Medical units in the field have lately received certain additional articles of operative equipment in the shape of an "outfit," which includes among other things a mouth-gag, tongue-forceps, and a Skinner's mask. Ether is also now available, while should the administration of oxygen be urgently indicated, even this commodity will frequently be at hand, though it must be remembered that oxygen cylinders are supplied to dressing-stations for another purpose and should accordingly only be made use of in cases of grave emergency. There is always plenty of lint and gauze, a stomach tube can be improvised, and there are good rubber hot water bottles. Lastly, there is a set of tracheotomy instruments of an up-to-date pattern. It will thus be evident at once that from the anæsthetist's point of view the equipment of a field ambulance leaves nothing to be desired. It may be added that all the materials supplied are of admirable quality.

The cases which may require the administration of an anæsthetic before being evacuated to a casualty clearing station may be divided into three main classes:—

(1) Cases where it is desirable to dress or redress a severe wound of an extensive nature or to immobilize a fracture.

(2) Cases where it is considered necessary to perform an immediate operation for the relief of some urgent symptom.

(3) Cases of wounds or injuries accompanied by shell-shock of an acute maniacal type.

In the first group of cases are included severe shell injuries which can only be thoroughly investigated when the patient is under an anæsthetic owing to the extent and situation of the wound. The cleansing and dressing of many cases of this type cannot possibly be carried out properly without anæsthesia, yet adequate

disinfection of a wound at an early moment may mean all the difference between recovery and death from septicæmia. Again, something more than the first-aid treatment of fractures is necessary in order to secure the comfort of patients who may subsequently have to make a journey of several miles in a motor-ambulance over bad roads. In these cases the value of anæsthesia in facilitating investigation and treatment is at once apparent. The administration of ether or chloroform is usually necessary in cases of severe burns, owing to the extreme pain which dressing of the parts entails.

It must be clearly understood that many of the cases in this first group would, in time of great stress and urgency, be evacuated from the dressing station almost immediately. It is at normal periods that the conditions are most suitable for the exercise of the methods outlined above. There are undoubtedly many advantages in dealing as effectively as possible with patients in field ambulances when the opportunity presents itself.

The majority of these cases offer the anæsthetist little difficulty. There are, however, certain complications which are always likely to be met with when a patient is anæsthetized within a short distance of the line. They may be briefly summarized as follows: (1) Shock; (2) hæmorrhage; (3) vomiting; cardiac collapse.

Shock is usually present in a greater or less degree in cases of extensive and destructive injury to the tissues, even when the part involved is in a relatively insensitive area. Hæmorrhage is of less common occurrence, the torsion of the vessels which usually takes place in the severe laceration resulting from large shell wounds effectually preventing much loss of blood. Occasionally severe venous bleeding has occurred before the patient's arrival at the dressing station, and he may then exhibit definite symptoms of collapse which call for the exercise of special care. An attempt should always be made to differentiate between collapse due to shock and that resulting from hæmorrhage, since treatment by intravenous saline, of the utmost value in some cases of hæmorrhage, would now appear to be contra-indicated in conditions of shock.[1]

Vomiting is of frequent occurrence and is often very troublesome. The explanation of its frequency is to be found in the fact that the patient has almost certainly been given a quanity of stimulating fluid to drink after being hit, either at the aid-post or on arrival in the field ambulance. Interrogation of a patient will often elicit the information that two or three cups of hot soup or coffee have been taken during the journey down from the trenches, with the result that the stomach is distended with fluid at the time of operation. It is well to bear this fact in mind and to remember that an empty stomach is the exception rather than the rule. In cases where a man has been wounded immediately after a heavy meal and has been brought in for operation a stomach tube should be passed and the gastric contents removed.

Symptoms of cardiac failure are not common in this class of case, but this possibility must always be guarded against in view of the fact that the patient has almost invariably been treated with an injection of morphia before coming under the anæsthetist's hands. It frequently happens that more than one injec-

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[1] "Surgical Shock and some Allied Conditions" (Medical Research Committee), *British Medical Journal*, March 24, 1917.

tion has been given, and I have seen cases where misguided energy in this direction has nearly led to the patient's undoing. A severely wounded man who has been given an excessive amount of morphia before being brought in is scarcely in a fit condition for the administration of an anæsthetic even under the most favourable circumstances. The greatest care is necessary in dealing with cases which have been overdosed in this way, circulatory failure occurring very frequently even under ether.

For the dressing of wounds and the immobilization of fractures anæsthesia may be conveniently induced with the A.C. mixture (alcohol one part, chloroform nine parts), and maintained with open ether or the original agent. Ether should not be used extravagantly or unnecessarily, for it is now an expensive commodity. It is, however, readily obtainable from the advanced depot of medical stores. The A.C. mixture is usually very well borne. It should be administered from a drop-bottle and should invariably be given by the open method on a folded square of lint held well away from the patient's face. Given under these conditions it forms an admirably safe and effective agent. Little muscular relaxation can, however, be produced at an early stage of anæsthesia, and the more complete degrees necessary for the manipulation of fractures are more readily obtained by the use of ether. The widespread habit of cigarette smoking is responsible for a great deal of chronic pharyngeal irritation, which is met with very frequently among patients of all ranks, and unless atropine $\frac{1}{120}$ grain is given as a routine practice before the commencement of etherization considerable difficulty may be experienced from the accumulation of mucus in the throat. Ether should be given by the open method, the mask being covered with eight thicknesses of gauze. A narrow ribbon of gauze may be interposed between the side of the bottle and the cork in order to maintain a continuous flow, a bottle with a perforated cork and two-way tube not being available.

Formal surgical operations are occasionally undertaken in field ambulances, immediate operative treatment affording the patient the only chance of recovery. The majority of such cases are of an exceedingly grave type, amputations and laparotomies being perhaps most common. These patients are naturally difficult subjects for anæsthesia and need the greatest care and attention. Induction is best carried out with a C.E. mixture (chloroform two parts, ether three parts) given on folded lint by the open method, anæsthesia being subsequently maintained with open ether and oxygen. I believe that pituitary extract is of real value in these cases in maintaining the blood-pressure and tiding the patient over a dangerous period. At the same time every effort should be made to maintain the body temperature, and too much stress cannot be laid on the necessity for keeping these cases under careful observation after they have been removed from the operating table. They should be placed in the warmest available position, while an orderly should be placed in special charge of each patient in order that he may be properly looked after and any change in his condition reported at once. In the hurry and confusion of dealing rapidly with a large number of patients these cases are apt to be neglected once the operation is over, chiefly owing to the fact that the nursing staff do not sufficiently realize the gravity of their condition. These operations, frequently undertaken under most adverse circumstances and solely with the idea of giving the patient some slight chance of recovery, are occasionally brilliantly successful, and the anæsthetist should be prepared to take any risk which the decision to operate may involve.

Certain cases of shell-shock arrive at the dressing station in a state of excitability bordering on acute mania. Very frequently such patients have some wound or injury which needs to be treated, but owing to the violence of their struggling it is often exceedingly difficult to deal with them. A little chloroform or C.E. administered very cautiously and gradually will save an infinite amount of time and unpleasantness, while the wounds can be properly dressed, the patient removed to a suitable spot, and due precautions taken before the return of consciousness. Unless there is reason to suppose that an injection of morphia has already been given, ½ grain may be administered, with an added small dose of hyoscine at the conclusion of anæsthesia.

NOTES ON THE TREATMENT OF AMŒBIC DYSENTERY WITH EMETINE AND BISMUTH IODIDE.

By Captain A. C. LAMBERT.
Royal Army Medical Corps.

During the months of July and August, 1917, forty cases of amœbic dysentery admitted to a military hospital in Mesopotamia were treated with emetine and bismuth iodide, used either alone or in conjunction with emetine hydrochloride.

These cases formed twenty-five per cent in July and thirty-four per cent in August of all cases admitted in which blood and mucus were present in the stools. They also furnished all the severe cases and the deaths from dysentery during the above period. Four deaths occurred, in two of which hyperpyrexia from the intense heat undoubtediy hastened the end. The remaining two were due to peritonitis following perforation of dysenteric ulcers, and occurred in very debilitated subjects two or three days after admission.

The duration of the disease before admission to this hospital varied from three days to a fortnight, the average being about six days. In many cases could be elicited a history of previous attacks of dysentery in either Mesopotamia or India.

All patients treated were natives of India, and came from widely separated districts of that country. As this was the first opportunity afforded the writer of making a trial of emetin and bismuth iodide in a series of cases of amœbic dysentery the diagnosis of which could be confirmed, and the results of treatment checked by microscopical examination of the fresh stools, the following points were considered worthy of investigation :—

(1) The tendency, or otherwise, of the drug to produce vomiting.

(2) Its action, either when given alone, or in conjunction with emetin hydrochloride, in

(*a*) Acute cases showing active amœboid forms in the stools ;

(*b*) Less acute cases in which encysting forms are appearing in the stools ;

(*c*) Chronic relapsing cases ; the results in all cases being checked by microscopical examination of the stools.

(1) The action of the drug in producing vomiting had to be taken into consideration, as keratin capsules were not available, and the drug had to be administered in the form of a powder or pill. Happily it was found that the Indian tolerates the drug very well. The maximum single dose of three grains was never exceeded, and not more than four grains were given during the twenty-

four hours. The most suitable dose was found to be one of two grains, in pill form, given once or twice a day, half an hour after a feed of milk, the pills being freshly made from the powder with a little gum excipient. A few of the cases complained of nausea after taking the drug, and sometimes the patient would vomit an hour or two later, but this was readily checked by the administration half an hour before of 15 drops of tinct. opii; tolerance was established in two or three days, and in no case did it become necessary to discontinue the drug from this cause.

(2) The cases divided themselves pretty definitely into the three classes given above, so that the action of the drug can be considered in its relation to each class.

Acute Cases.

In those cases in which the disease had been present three or four days, and in which several stools containing mainly blood and mucus were passed during the twenty-four hours, microscopical examination showed the presence of numerous amœbæ of histolytica type. In the treatment of this class, the best results were obtained by using two grains of emetin and bismuth iodide in pill form at night, and one grain of emetine hydrochloride hypodermically in the morning. A more rapid relief of the acute symptoms was obtained by this method than by the use of either drug alone; in fact, emetin and bismuth iodide when given alone in acute cases did not appear to have the same rapid action in relieving pain and tenesmus as emetin, but when used in combination with the latter drug in the above manner it certainly shortened the attack, and established a more complete and earlier convalescence. The rapidity with which the stools became fæcal and lost their blood and mucus was in some cases remarkable. Furthermore, there did not appear to be the same tendency to constipation, which so frequently follows the use of emetin alone.

The microscopical findings showed a rapid decline in the number of amœboid forms in the stools after twenty-four hours, and by the end of a week the stools were reduced to one a day, were in appearance normal, and apparently free from amœbæ in any form.

Case 1.—Havildar major, admitted August 5, 1917, with symptoms of dysentery. Had been in hospital a fortnight previously with diarrhœa, which cleared up under salines. No amœbæ found at that time in the stools. On second admission he was passing five or six stools daily, consisting solely of blood and mucus, and containing numerous amœbæ of histolytica type. Emetine, one grain hypodermically in the morning and emetine and bismuth iodide three grains in pill at night, commencing on August 6. Slight nausea, but no vomiting after taking pill. Toleration established after two days.. On August 10, dose of emetine and bismuth iodide reduced to two grains. Blood and mucus absent from stools on August 8, and pain and tenesmus disappeared. Stools one daily, semi-solid, until August 14, when they became solid and free from amœbæ. Returned to duty on August 17. Total emetine injected, twelve grains. Total emetine and bismuth iodide given, twenty-eight grains.

Case 2.—Driver, admitted July 23, 1917, with severe acute dysentery of four days' duration. Passing numerous stools containing much blood and mucus. Active amœboid forms of *E. histolytica* present. Treatment commenced on July 24, with emetine one grain hypodermically in the morning, and emetine

and bismuth iodide three grains at night. Griping and tenesmus relieved after twenty-four hours. Blood and mucus in diminishing quantities present in stools up to August 1. One normal stool passed on August 3, which was free from blood, mucus and amœbæ. Patient then transferred to another hospital.

Subacute Cases in which Cysts were Present.

In cases which had passed the acute stage when admitted, and whose symptoms consisted of pain and tenderness along the course of the large bowel, more marked over the cæcum and lower part of descending colon and rectum. and the passage daily of two or three semi-solid or liquid fæcal stools containing a little mucus and a trace of blood; good results were obtained by giving two grains of emetine and bismuth iodide in pill morning and evening, with an occasional dose of ½ ounce of sulphate of soda. Mucus and blood disappeared rapidly under this treatment, the tongue became clean, and the abdominal tenderness diminished, while, so far as could be judged with the laboratory appliances at disposal, cysts ceased to be found after five or six days of treatment. Treatment was continued until a total of thirty-six to forty grains of emetin and bismuth iodide had been taken. Diet consisted of milk, sago and rice pudding, chicken soup and eggs.

Case 3.—Sepoy, admitted on August 18, 1917, complaining of diarrhœa, pain and tenderness along the course of the large bowel and the passing of small quantities of blood and mucus in the stools, of which he had two or three daily, Duration of illness fifteen days. No history of previous attacks. Two and four-nuclear cysts found in stools. After a preliminary dose of ol. ricini, treatment was commenced on August 19 by giving two grains of emetine and bismuth iodide morning and evening. Blood and mucus were absent on August 21, and the stools were normal and apparently free from cysts on August 23.

Case 4.—Driver, admitted on August 16 1917, complaining of diarrhœa, with the passage of small amounts of blood and mucus. Two to three stools daily. Illness of about a fortnight's duration. No history of previous attacks. Cysts in stool containing up to four nuclei. Emetine and bismuth iodide in two-grain doses twice daily commenced on August 18. Stools normal and free from cysts on August 21.

Chronic Relapsing Cases.

Under this category are classed cases who had had one or more previous attacks of dysentery from which they had never fully recovered. When admitted to hospital they were very debilitated and anæmic. Usually of the "follower" class, they had continued their duties long after they should have reported sick. The stools passed, often sixteen to twenty in a day, consisted of blood, mucus and sloughs, while not infrequently blood alone was passed, and in considerable quantity. Great tenderness was complained of along the whole course of the large bowel, and there was much griping and tenesmus. Emaciation was extreme in some cases. These cases furnished all the four deaths occurring during the period under review, and the post-mortems showed extensive ulceration and gangrene of the whole of the large bowel from cæcum to anus. The stools contained numerous amœbæ in all stages of development. Owing to the severity of the symptoms it was necessary to get these patients as quickly as possible under the influence of emetine, in order to destroy the amœboid forms which were

doing such harm to the already damaged coats of the bowel. Emetine hydrochloride, therefore, was given at first in doses of from a half to one grain, hypodermically twice daily. Later on, as the symptoms improved, one or two grains of emetine and bismuth iodide were substituted for one of the doses of emetine. Small doses of morphia were used to allay pain and tenesmus, and promote sleep. Stimulants, such as brandy or port wine, had generally to be given, and in such debilitated cases the diet had necessarily to be bland, nourishing, and readily assimilable, and consisted of milk, milk and eggs, meat essences, milk puddings and light soups. Convalescence in these cases was prolonged, and return to normal dietary had to be carefully regulated.

Case 5.—Dhoolie-bearer D., admitted on August 6, 1917, with diarrhœa and debility, and a history of several weeks of ill-health, abdominal pain and the passing of mucus with the stools. He was passing from sixteen to twenty stools daily, was very weak and emaciated, and could scarcely articulate. He had continued on duty till forced by weakness to seek medical aid. Liver and spleen not palpable. Temperature 99° to 100° F. Pulse very rapid and weak. Tongue furred, dry, and protruded with difficulty. Lungs showed poor air entry and signs of old pleurisy. He was at first considered to be a case of phthisis, with diarrhœa, but no tubercle bacilli could be detected in the sputum. Blood was negative as regards malaria. Examination of stools showed, at first, no amœbæ, but on the 10th there was a little blood and mucus in the stool, and amœbæ were then found. He was at once put on emetine hypodermically, in doses of one grain daily, and on the 13th, when the symptoms had improved, and his general condition was better, two grains of emetine and bismuth iodide were given in the evening to supplement the emetine. The former drug was well borne and caused no vomiting. By the 15th there was slight improvement, but patient was still very weak aud depressed and was passing five or six stools a day. On the 17th he was much better, and there was no blood and mucus in the stools, and the emetine was discontinued. On the 19th, the stools contained neither amœbæ nor cysts, but the emetine and bismuth iodide were now given in two-grain doses twice daily. The appetite had returned, and the patient commenced to pick up. Medicinal treatment was stopped on September 1, after a total of nine grains of emetine and forty grains of emetine and bismuth iodide had been given. A few days later the patient was transferred convalescent to another hospital.

The above case is a very fair illustration of the action of emetine and bismuth iodide in severe amœbic dysentery in debilitated subjects.

No mention has been made of the use of enemata, and, in fact, very little use was made of that method of treatment. In the milder cases it did not appear called for, and in the severe type similar to the last described it seemed to be a highly dangerous proceeding, considering the state of the bowel in these cases, as illustrated post mortem. Appendicostomy or cæcumostomy were not attempted, as the cases were too debilitated to stand operative interference, and their symptoms appeared to be relieved to a great extent by medication.

Judging by the results in this small series of cases, it would seem that we have in emetine and bismuth iodide a combination of considerable potency in the treatment of amœbic dysentery, particularly when the amœbæ are assuming their resistant stage. When given in pill form in doses not exceeding two grains, its emetic effects are slight, at all events in Indian cases. Its use in conjunction

with hypodermic injections of emetine hydrochloride in acute amœbic dysentery would seem to be beneficial, in that convalescence is established earlier and patients are less likely to become "carriers." It cannot be considered in the light of a substitute for emetine, as attempts to treat acute cases with it alone ended in failure, until emetine was used in addition.

In "carriers" and in those convalescents who continue to harbour cysts, emetine and bismuth iodide should prove superior to emetine, and it would seem a wise proceeding, from a public health point of view, to subject all cases of amœbic dysentery to a course of emetine and bismuth iodide during convalescence.

I wish to express my grateful thanks to Colonel W. H. Willcox, C.B., A.M.S., consulting physician to the forces in Mesopotamia, for his kind and valuable advice and help in the treatment of the cases, and the compilation of these notes. And also to my indefatigable assistant, Sub-assistant Surgeon Bashi Ram, without whose intelligent aid and knowledge of the vernacular the cases could not have been systematically treated or noted.

NOTES ON THE TREATMENT OF SUBTERTIAN CEREBRAL MALARIA WITH QUININE AND GALYL.

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AND
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Salvarsan and neosalvarsan have been used to a considerable extent during the last six or seven years in the treatment of malaria. Most observers are agreed that these drugs, especially when associated with quinine, are of value in infections with the benign tertian and quartan parasites, but are of little value against infections with the *Plasmodium laveraniæ*. Although quinine alone may justly be termed a specific in the treatment of most types of malaria, the death-rate from malignant subtertian malaria is yet sufficiently high to stimulate further effort to find an even more efficient therapy.

The following six cases were treated with a combination of quinine and galyl :—

Case 1.—Pte. C., aged 31, admitted to base hospital on September 22, 1916. He had reported sick on September 18, complaining of headache, vomiting, and "the shivers." He stated that for the previous three months he had been having attacks of shivering and sweating at irregular intervals. On admission to hospital his general condition was good, his temperature was normal, and his spleen extended half an inch below his costal margin. He was treated with twenty grains of quinine sulphate three times a day by mouth. He felt quite well and his temperature remained normal until the morning of September 25. On that date his temperature rose to 100° F. and remained up all day. On the morning of the 26th it had fallen to normal, but rose again in the evening to 101° F., and the patient felt sick and vomited. An injection of twenty grains quinine bihydrochloride was administered intramuscularly. On the morning of the

27th another injection of twenty grains of quinine was given intramuscularly. His temperature was normal, and did not rise above normal throughout the day. At noon the patient refused his food, and looked strange; at 3 p.m. he was found to have complete paralysis of the muscles of both sides of the tongue, of the pterygoids and of the masseters. There also appeared to be some weakness of the external recti. There was no paralysis of the limbs, or alteration of the superficial or deep reflexes. The patient was quite conscious and could carry out directions as to the movements of his limbs; the fundi oculorum were normal. A blood-film showed the presence of numerous subtertian rings and crescents. He was given an intravenous injection of 0·8 gramme quinine bihydrochloride. At 8 p.m. the patient's condition was unchanged, except that he now appeared to have some difficulty in understanding what was said to him. There was a definite internal strabismus of the left eye; a further 0·8 gramme quinine was administered intravenously. On the morning of the 28th his condition was much improved. He could open his mouth, protrude his tongue, and articulate slowly. He had some difficulty in swallowing, as fluids tended to regurgitate through the nose. There was still defective movement of both eyes outwards. In the afternoon his temperature rose to 100° F. On this date he was given two intravenous injections of quinine bihydrochloride 0·8 gramme each. On the morning of the 29th his condition was much worse. There was complete paralysis of the tongue, the palate, and the muscles of mastication. There was also complete ophthalmoplegia, and it was doubtful whether the patient understood what was said to him. At 9 a.m. he received a further 0·8 gramme quinine bihydrochloride intravenously. At 11 a.m., as there was no improvement in his condition, he was given 0·3 gramme galyl intravenously. At 3 p.m. the patient was much improved. He could then protrude his tongue, move his jaw, talk slowly but quite intelligently, swallow slowly, and move his eyes. At 9 p.m. he was given a further 0·8 gramme quinine intravenously. On the 30th the patient's condition had continued to improve. There was still some dysarthria, but he was able to swallow without difficulty. He was put on 20 grains of quinine sulphate three times a day by mouth. The improvement steadily continued, but on October 1, as the temperature still rose to 100° F., he was given 0·2 gramme galyl intravenously. The temperature fell that night and remained subnormal during the rest of his stay in hospital. He showed no further symptoms and was transferred to hospital ship on October 18, when there was no evidence of organic nervous disease, and no malarial parasites could be found in the blood.

Case 2.—Sapper R., aged 33, admitted to base hospital on October 4, 1916. On admission the patient's general condition was bad, and the temperature was 103° F. He showed no evidence of any local lesion of the nervous system. A blood-film showed the presence of numerous subtertian malarial parasites. He was given 0·8 gramme quinine bihydrochloride intravenously. On the morning of the 5th his temperature was subnormal, but his general condition was very poor. He was again given 0·8 gramme quinine intravenously, and at 2 p.m. twenty grains of quinine sulphate by mouth. In the afternoon the patient developed marked dysarthria and difficulty in swallowing. The speech was quite unintelligible. The movements of the tongue and palate were present but much impaired. The patient's mental condition was not affected, and there was no paralysis of the limbs or alteration in the superficial or deep

reflexes. At 6 p.m. he received 0·4 gramme of galyl intravenously. On the 6th the patient's general condition was much improved, and beyond slight dysarthria, which rapidly passed off, he showed no evidence of local disease of the nervous system. He was then treated with quinine intramuscularly, and later by mouth, and rapidly became convalescent. He was transferred to hospital ship on October 21, without any evidence of organic nervous disease.

Case 3.—Pte. B., aged 48, admitted to base hospital on the night of October 7, complaining of headache and general weakness. On admission his temperature was 103° F., but fell to 99° F. on the morning of October 8. His general condition was fair, and his spleen extended about one inch below the costal margin. He was treated with twenty grains of quinine sulphate three times a day by mouth. He took his dinner at noon on the 8th without discomfort, but at 4 p.m. it was found that he was unable to swallow his tea, and he rapidly became unconscious. A blood-film showed the presence of numerous subtertian rings and crescents. When seen at 5 p.m. he was lying in a semi-conscious condition, and did not pay any attention to what was said to him. The conjunctival reflex was present and the superficial and deep reflexes were normal. The unconsciousness rapidly deepened, and he could not be roused by any stimulation. He received 0·8 gramme of quinine bihydrochloride at 5 p.m., 7 p.m., and 10 p.m. At 11 p.m. his condition was unchanged, except that his pulse was failing. He then received 0·4 gramme of galyl intravenously. When seen at 6 a.m. next morning he was quite conscious, able to answer questions slowly and intelligently, and swallow. His temperature was subnormal, and remained so for the remainder of his stay in hospital. A blood-film showed the presence of scanty subtertian crescents up to October 15, but he showed no further symptoms and was transferred to hospital ship on the 22nd.

Case 4.—Pte. C., aged 26, admitted to the base hospital on October 10. On admission the patient's general condition was poor, his temperature was 99° F. and his spleen extended about one inch below his costal margin. A blood-film showed the presence of rings and crescents. He tended to be drowsy, but answered questions quite intelligently, and had no complaints. He was given 0·8 gramme quinine bihydrochloride intravenously. On the morning of the 11th the patient's general condition was worse, he was more drowsy, and answered questions with difficulty. The pulse was 120 per minute and feeble. He received fifteen grains of quinine bihydrochloride intramuscularly. At 3.30 p.m. his condition suddenly became much worse; his breathing became stertorous, and his pulse imperceptible; he lay moaning incessantly, and rolling his head from side to side. There was no paralysis, and his superficial and deep reflexes were normal. His temperature was subnormal. At 4 p.m. he became violent, and lay on his left side in the typical attitude of cerebral irritation. He violently resisted any interference with this position. He received 0·4 gramme galyl intravenously. At 9 p.m. the patient's condition had definitely improved. He had slept for two hours and his pulse was better. At 1 a.m. on the 12th he again became rather excited, and was given $\frac{1}{150}$ grain hyoscine. After this he slept, and when he woke was rational, though weak. From this date he rapidly and steadily improved, and on the 22nd was transferred to hospital ship without presenting any further local symptoms.

Case 5.—Pte. L., aged 20, admitted to the base hospital on October 15, 1916, with a diagnosis of malaria. On admission his temperature was normal and he presented no local symptoms. His spleen extended half an inch below the costal margin. He had never suffered from fits nor had any of his family done so. On October 16, whilst in the latrine, he suddenly developed an epileptiform fit. After having been brought back to the ward, he was in a very confused condition, and paid no attention to any questions, but constantly attempted to get out of bed. The blood-film did not show any malarial parasites. His temperature had risen to 101·4° F. During the 16th he continued to have epileptiform fits, and in the twenty-four hours had some twelve in all. The clonic convulsions were general and did not appear to begin constantly in any particular part, but they were always associated with marked deviation of the head and eyes to the left. Between the fits he was either extremely drowsy or violently delirious. At 2 p.m. he received 0·8 gramme quinine bihydrochloride intravenously, and at 6 p.m. twenty grains intramuscularly. On the morning of the 17th his temperature was 101° F. and his pulse-rate 80 per minute. He was very drowsy and had passed no urine. He received twenty grains quinine intramuscularly. At 9 p.m. he developed another fit, and it was noted that the left plantar reflex was extensor; the right plantar reflex was flexor. He was given 0·4 gramme galyl intravenously, and a lumbar puncture was performed. The cerebrospinal fluid appeared to be under increased pressure, and two testtubefuls of clear fluid were drawn off. The cerebrospinal fluid showed no increase in cellular elements. At 8 p.m., as he had passed no urine for thirty-six hours, a catheter was passed, and less than an ounce of urine was obtained. It did not contain any albumin, sugar, or casts. On the morning of the 18th the temperature was normal, and the patient's general condition improved. He answered questions quite readily and was taking his nourishment well. The left plantar reflex was still extensor, and there were marked nystagmoid jerkings of the eyes on lateral movement to either side. The left leg was distinctly weaker than the right, but was capable of performing all movements with a fair amount of force, and there did not appear to be any ataxia of the limbs. Urine was being passed quite freely. He was given two doses of twenty grains quinine intramuscularly on this date. From this date onwards he was treated with quinine, at first intramuscularly, and later on by mouth. Convalescence was uninterrupted. The weakness of the left leg rapidly improved, but the plantar reflex remained extensor for four weeks. The nystagmoid jerkings of the eyes varied somewhat from time to time, but were still definitely present six weeks after the patient's admission to hospital. When able to get up he showed a pronounced reeling gait, and unless supported he tended to fall to the left. He stated that he felt as if his head were being pulled to the left. When made to walk holding his head down to his right shoulder with his right hand, the tendency to reel to the left was diminished, but was still present. There was no Rombergism and no ataxia. The optic disks were normal. He had no further fits after the 18th, and was transferred to hospital ship in February, 1917.

Case 6.—Dr. S., aged 22, admitted to hospital on September 29, 1916. He reported sick on the 21st, complaining of pain in the head and back, and diarrhœa. On admission to hospital, his general condition was fair, his temperature 103° F., his pulse 120 per minute, and his spleen two inches below the costal margin.

He was put on forty grains of quinine sulphate by mouth per day. On October 2, as the temperature was still raised he was given twenty grains of quinine bihydrochloride intramuscularly in addition. On the 4th his temperature did not rise above 99° F., and he appeared somewhat better. On the 5th the temperature again rose to 101·4° F., and he complained of some pain in the neck and a little difficulty in swallowing. No definite affection of the cranial nerves could be made out, but the right plantar reflex was definitely extensor. He was again put on quinine intramuscularly. On the 6th the temperature again rose; he still complained of pain in the neck, and the right plantar reflex was still extensor. The respirations had increased in frequency, and there was some dullness at the base of the right lung posteriorly. He was given two doses of 0·8 gramme quinine intravenously. On the 7th, as there was no improvement, he was given 0·4 gramme galyl intravenously. He died on the morning of the 8th.

Post-mortem.—The whole of the upper and lower lobes of the right lung were solid in a condition of grey hepatization. There was a considerable accumulation of cerebrospinal fluid below the tentorium and some œdema of the pia-arachnoid over the pons and medulla. The brain was hardened in formalin and then sectioned, but it did not show any macroscopic change.

In these six cases galyl was used in association with large doses of quinine. So far we have been able to make only a limited number of observations of the effect of galyl alone on the subtertian parasites in the peripheral blood-stream, but that galyl alone can cause the disappearance of the ring forms of parasite from the peripheral blood-stream is shown by the two following cases.

Case 7.—Sister S., aged 28, admitted to hospital on November 12, 1916, with pyrexia. Numerous subtertian rings were present in the blood. The patient was put on twenty grains quinine sulphate three times a day by mouth. This produced constant vomiting, headache, and very troublesome tinnitus aurium. The parasites persisted in the blood-stream and the pyrexia continued. On November 14 she was put on intramuscular injections of quinine bihydrochloride, twenty grains twice a day. The intramuscular injections were continued for four days, but the patient was extremely intolerant of quinine and complained of violent headache, and tinnitus aurium with occasional vomiting. The temperature was swinging between 97° and 101° F. Subtertian rings were constantly present in considerable numbers in the blood. She was again put on quinine by mouth, but, on account of vomiting, it was impossible to get her to take it regularly. An intermittent pyrexia continued up to November 27, and during this period subtertian rings were constantly present in the blood. On November 27 she received 0·2 gramme galyl intravenously. Her general condition definitely improved, but the blood still showed subtertian rings, although in diminished numbers, up to December 6, when she had a second dose of 0·4 gramme galyl. From this date onwards there was a marked general improvement in her condition, although she still continued to show an irregular pyrexia rising to 100° F. at night; her blood was examined every few days for malarial parasites until her discharge some two months later, but these were not again found. On December 10 typhoid bacilli were isolated from the stools, and on January 2, 1917, she developed a periostitis of the right humerus.

Case 8.—Pte. B., aged 26, elsewhere reported in detail, was admitted to hospital on the night of October 4, 1916. On October 5 his temperature rose

to 102° F.; his general condition was poor, his sclerotics icteric, and he presented gangrene of the toes of both feet. A blood-film showed the presence of rings and crescents, anisocytosis, poikilocytosis, and polychromatophilia. As it was considered possible that a vascular spasm aggravated by quinine might play a part in the condition of the feet, he was not put on quinine but given 0·3 gramme galyl intravenously. His temperature fell that night and remained subnormal throughout the rest of his stay in hospital. His general condition rapidly improved, and a blood-film taken on the 10th was reported negative to malarial parasites. Two other blood-films taken later were also reported negative. Before his discharge to hospital ship he was put on ten grains of quinine sulphate twice a day by mouth.

In this case it will be noted that the crescents also disappeared rapidly from the blood, but in most of our cases of combined quinine and galyl treatment the crescents have been much more persistent, as in the following case.

Case 9.—Pte. K., aged 25, admitted to hospital on December 23, 1916, with a diagnosis of bronchitis. The patient had been in hospital in May, 1916, with a diagnosis of P.U.O., and in October with malaria. He had not felt well since leaving hospital in October, and he stated that he had had frequent shivering fits since then. During September and October he had taken thirty grains quinine by mouth per day, but had only been taking it irregularly in November and December. On admission his general condition was poor. His temperature was 102° F. and rose to 103° F. next day, to fall to normal on the 25th. His blood showed numerous subtertian crescents and rings. From December 24 to 27 the number of crescents met with in counting 200 leucocytes was practically constant, the figures being 100 crescents to 200 leucocytes. On the 27th he was given 0·4 gramme galyl intravenously. On the 29th the crescents had fallen to 50, on the 30th to 36, for every 200 leucocytes. On the 30th he again received 0·4 gramme galyl. On December 2 the crescents had fallen to 24 in 200 leucocytes, on the 3rd to 14, and on the 4th to 7 crescents for every 200 leucocytes. On the evening of the 11th he developed catarrhal symptoms with a temperature of 101° F., but without any rigor. A similar condition was at that time present in the ward and was almost certainly not malarial. The temperature was normal on the 6th, and on the 6th and 7th the crescents numbered respectively 11 and 10 to 200 leucocytes. He received another 0·4 gramme galyl on the 7th. On the 8th his temperature rose again and he had a malarial attack. Rings were found in the blood on the 9th. His temperature became normal again on the 11th and his blood showed no rings, but 23 crescents to 200 leucocytes. He was put on forty grains quinine bihydrochloride intramuscularly once a day, and twenty grains quinine sulphate twice a day by mouth. On the 13th, 14th and 15th his blood showed 8, 7 and 8 crescents respectively to 200 leucocytes. On the 23rd and 24th 1 crescent to 200 leucocytes was found, and on the 25th and 26th no crescents could be found in counting 300 leucocytes. On February 1, 1 crescent was found in counting 200 leucocytes, on the 2nd, 3 crescents to 200 leucocytes. On the 4th and 6th no crescents were found in counting 400 and 300 leucocytes respectively. His general condition was now excellent and he was transferred to hospital ship on February 7th.

With regard to the value of combining galyl with quinine in serious cases of malaria, our experience is yet too limited to permit of any dogmatic statements

as to its efficacy. It will be noted that, in the first six cases reported here, all were seriously ill with definite subtertian cerebral malaria. All the cases recovered, with the exception of one who died of a complicating croupous pneumonia. All had received quinine, several of them large doses by mouth, intramuscularly, and intravenously, without clinical improvement. In all of them, with the exception of the fatal case, the clinical improvement after the administration of galyl was striking and immediate. In none of the cases did the injection produce any unpleasant results, although several of the cases appeared almost moribund before the injection.

In the eighth case, in which it was considered inadvisable to give quinine, galyl alone caused the disappearance of the parasite from the peripheral blood and produced a striking improvement in the condition of the patient.

In Case 7 the patient took quinine in any form with great difficulty, and although she had taken a considerable amount of quinine by the mouth and intramuscularly, ring forms of the subtertian parasite were constantly present in the blood. After the first half-dose of galyl there was a notable clinical improvement, but the parasite could still be demonstrated in the blood. After the second dose the parasites at once disappeared from the blood. The typhoid ran a protracted course, and she developed a periostitis of the left humerus, but in spite of repeated examinations parasites were not again demonstrated in the blood during the rest of her stay in hospital.

In Case 9, subtertian crescents were present in large numbers. Under treatment by galyl alone they diminished from 100 per 200 leucocytes to seven or eight. The patient's general condition very greatly improved, but he still developed a malarial attack with the presence of rings in the blood. These rings disappeared under treatment by intramuscular quinine, and the crescents continued to diminish and were absent on February 7, when he was transferred to a hospital ship.

We consider that we are justified in concluding:—

(1) That the treatment in itself is free from danger.

(2) That, in subtertian malaria which is resisting adequate quinine treatment, or where the condition is sufficiently alarming, the results of the combined galyl and quinine treatment have been encouraging enough to justify a further trial. It must be thoroughly understood, however, that the addition of galyl in no way diminishes the necessity for quinine.

(3) That in cases where, on account of idiosyncrasy, quinine is impossible, a valuable substitute may be found in galyl.

We take this opportunity of thanking Colonel Purves Stewart, C.B., A.M.S., consulting physician to the Salonika Force, for his valuable assistance and advice, which was always at our disposal. To Lieut.-Colonel P. Mitchell, R.A.M.C., T.F., we are also indebted for permission to use the hospital records, and to Captain R. Richards, R.A.M.C., T.F., for the hæmatological and post-mortem reports.

CEREBROSPINAL FEVER: NOTES ON 251 CASES TREATED AT THE SALISBURY ISOLATION HOSPITAL.

By J. E. GORDON, M.R.C.S., L.R.C.P.

Hon. Physician Salisbury Infirmary; Medical Officer in Charge of Salisbury and District Joint Isolation Hospital.

The following brief notes relate to cases of cerebrospinal fever which have occurred in Salisbury and the surrounding district and in some neighbouring military camps, from December 15, 1914, to June 30, 1917.

The first case was admitted to the Salisbury Infirmary on December 15, 1914, and from that date until February 23, 1915, 36 cases were admitted; of this number, 16 died in the Infirmary, 3 recovered and were sent back to their homes, and the remaining 17 were transferred to the Salisbury and District Joint Isolation Hospital on account of the impossibility of treating the increasing numbers of cases in a ward of a General Hospital. Five of these 17 subsequently died at the Isolation Hospital. The total number of cases, both military and civil (including the 17 mentioned above), admitted from February 23, 1915, to the Isolation Hospital, was 232, making the total number of cases admitted into both hospitals 251.

The following table gives separately the number of military and civil cases, the recoveries and the deaths at all ages and at certain age groups, and the percentage of the fatal cases to the total number of cases in each age group:—

Number of cases at certain age groups	Number of cases	Number of recoveries	Number of deaths	Percentage of deaths to cases	
Military.					
Total number at all ages	155	101	54	34·8	
Number under 20 years of age	54	31	23	42·6	
,, 20 to 25	55	40	15	27·3	
,, 25 to 30	21	13	8	38·1	
,, 30 to 40	17	11	6	35·3	
Over 40	8	6	2	25·0	
Civilian.					
Total number at all ages	96	40	56	58·3	
Under 1 year of age	8	3	5	62·5	69·8
1 to 5 years	21	5	16	76·2	
5 to 10 ,,	14	6	8	57·1	
10 to 15 ,,	10	2	8	80·0	
15 to 25 ,,	19	12	7	36·8	38·9
25 to 45 ,,	17	10	7	41·2	
45 to 65 ,,	6	1	5	83·3	85·7
Over 65 ,,	1	—	1	100·0	

From the table above it will be seen that the fatality rate of the military cases, 34·8 per cent, is lower than the corresponding rate for civil cases, 58·3 per cent. The higher fatality rate at all ages among the civilians may in some measure be attributed to the comparatively large proportion of fulminant cases which occurred in the cases in the 1914 to 1915 epidemic period; but in the main it is due to the fact that many of the cases were infants and young children. It will be seen that 53 (or 55·2 per cent) of the civilian cases are under 15 years of age, having a fatality rate of 69·8. Among persons past middle life the mortality rate was also high (85·7 per cent).

When the thirty-six (37·5 per cent) civil cases in the age groups 15 to 45, which most closely correspond to the all-ages group of the military cases are examined,

it will be seen that the fatality rate of the civil cases is 38·9 per cent, and that of the military cases 34·8 per cent. Although the civil fatality rate is four per cent higher than in the military cases, the rates are calculated on small figures, and too much reliance cannot be placed on them.

Of the 251 cases dealt with, there were 47 fulminant cases, 163 severe cases, and 41 mild cases.

The length of illness of 110 fatal cases was as follows:—

Period of illness	Civil cases	Military cases
Less than one week	24	25
One to two weeks	5	4
Two to four weeks	8	12
Over four weeks	19	13
	56	54

The longest duration of illness before death was 129 and 131 days respectively in civil and military cases.

In the civilian cases there were 56 males, and of these 21 recovered and 35 (or 62·5 per cent) died; and 40 females, 19 of whom recovered and 21 (or 52·5 per cent) died.

The civilian cases, with few exceptions, occurred amongst the working classes, and except in three cases there was a definite history of association with soldiers or camp workmen, or of residence in camp areas.

Civilian patients within a radius of twenty-five miles were conveyed to the hospital by motor ambulance, and even the most severe cases seemed to stand the journey well.

The ambulance used was a 20-h.p. Scout, body of wood, panels with glass windows, interior varnished wood, all washable. The patient was kept warm with hot-water bottles and blankets.

Age Distribution.—The disease may occur at any age, among the cases treated at Salisbury the youngest was 3½ months, and the oldest aged 72 years.

Clinical Symptoms and Signs.

In all cases headache was present, usually of a severe type, and there was pain and stiffness on moving the head in varying degrees according to the severity of the case. In two very severe cases there was no stiff neck on admission, but in twenty-four hours this sign was pronounced. Difficulty in swallowing, due to extreme retraction of the head, was present in a few cases. Vomiting, sometimes associated with diarrhœa, was present in 162 cases on admission, and had probably been present in some of the cases admitted unconscious, in regard to which no history of the illness was obtainable. Kernig's sign was present in 199 cases. Twenty cases had herpes on the face on admission. Many cases had rashes on admission, the eruption being of various types, papular, hæmorrhagic, and purpuric spots being most common; two cases had petechial rashes on the joints. Broncho-pneumonia was present in fifteen cases. Bronchial symptoms of a catarrhal type, probably meningococcal in character, occurred in some cases; these were usually of a temporary transient character, lasting only a few days, and did not seem to influence the course of the disease. Convulsions occurred in seven cases at the commencement of the illness; three of these cases were under 1 year of age; of the remaining four, one was 3½ years, one 7½ years, one 18 years, and one 26 years of age. With three patients convulsions occurred at a late stage of the disease, only one of these recovered. Retention of urine (m

frequently observed in female cases) did not indicate a bad prognosis when occurring at an early stage of the illness; it also occurred as a late development in hopeless cases. One hundred and twenty-nine cases, when admitted, were more or less unconscious with delirium, frequently violent and maniacal. Some cases were quite comatose. Hæmaturia was present in four military cases of severe type, two of which were fatal. The other two made a complete recovery. Albuminuria occurred in 11 cases—10 military and 1 civilian—3 of these cases died. Of the recovery cases, one only had albuminuria on leaving the hospital. Strabismus when present generally occurred in infants. A child, aged 5, who recovered, had ptosis of the right eyelid on admission. At least four patients recovered with blindness of one eye, caused by panophthalmitis, and in two cases the eye was subsequently removed. Nystagmus occurred in one case as a complication and sequela, the patient when discharged being otherwise in good health. In three cases orchitis occurred as a complication during convalescence. Total deafness occurred as a sequela in three cases in which recovery was otherwise good. One patient, a male, aged 29, who died after five days' illness, had hemiplegia on admission. Another male, aged 18, had facial paralysis, but recovered with no paralysis. Hydrocephalus was occasionally seen amongst the children affected.

The Type of the Disease.

Acute Fulminant Type.—Duration of illness from a few hours to five or six days. These cases were usually comatose or semi-comatose on admission with hæmorrhagic rash and incontinence; they were often delirious and troublesome and did not recover consciousness.

Severe Type.—These cases present several varieties; on admission, some did not appear to be very severe, but became so and ended fatally in two or three weeks; others became chronic, the course of the disease lasting sometimes several weeks before death occurred. The latter patients became very emaciated with mental degeneration and incontinence. The rapid recovery of some patients admitted with delirium and high temperature and apparently suffering with a most severe form of the disease, was remarkable. As a rule in severe cases which recovered improvement began in less than two weeks, although it is worthy of note that certain severe cases began to recover after a long period.

Mild Types.—These cases had headache, stiff neck, and generally vomiting; were sensible on admission, and Kernig's sign was present. Convalescence commenced a few days after admission. Cultures from cerebrospinal fluid or throat swabs were positive. The cerebrospinal fluid in these cases was generally excessive in amount, either clear or faintly turbid (cloudy).

Chronic cases became emaciated; those ending fatally usually developed tremor of the hands, sometimes purpuric or petechial rashes, loss of memory and incontinence, and usually took nourishment well. Mental derangement in a chronic case, associated with wasting, tremor, and incontinence, indicate, I consider, a fatal termination; in fact I have only seen one case with these signs recover. On the other hand, I have had recoveries of cases with emaciation, in which the mental capacity has remained good, and after the acute stage the patients have not had incontinence. Three patients were admitted with swollen joints and myocarditis, their condition before admission suggesting acute rheumatism. In these cases meningococci were found in films made direct from cerebrospinal fluid, which in all these cases was turbid and excessive in amount; two of these

cases recovered, the cardiac signs and swelling of the joints disappearing during convalescence. Arthritis affecting the knee or ankle joints occurred in seven patients as a complication or sequela, two of these being fatal cases. The temperature does not appear to take any definite or typical course. Cases with some of the highest temperatures recorded recovered, and in some severe cases of the fulminant type, where the illness ended fatally in a few days, the temperature did not rise above 100° F., or remained normal.

Diagnosis.—For correct diagnosis, lumbar puncture is essential. The cerebrospinal fluid of the first forty-five cases was examined and reported as positive by Dr. Penfold, of the Lister Institute. Of the remaining cases the fluid of 163 was more or less turbid and diplococci were found in films made from the fluid withdrawn, although in some of these cases no growth was obtained from cultures on trypsin agar or blood serum (about 15½ per cent). In two cases the fluid was blood stained, and in one of these diplococci were found and a positive growth was obtained; in the other case no growth resulted, but a throat swab furnished a positive growth. In forty-one cases the cerebrospinal fluid was clear and excessive in amount. In these cases the albumin was generally increased, and in some eight of them a positive growth was obtained by culture. In the other clear fluid cases, the diagnosis was confirmed by subsequent punctures and a positive throat swab was obtained.

The amount of fluid withdrawn varied, the average being from thirty to fifty cubic centimetres. In some cases the fluid was in quantity and under considerable pressure, as much as eighty or 100 cubic centimetres escaping at times through the needle. The cells found in the fluid were chiefly of the polymorphonuclear variety, the diplococci being both extra- and intra-cellular. I have not found the position of the cocci, as regards the cells, to afford any assistance in prognosis. One patient, a male, recovered with nephritis as an after effect; four cases (already mentioned) with impaired vision. In the majority of cases which recovered health has not been completely restored for some months; in others the recovery appeared to be fairly good, many patients having resumed their occupations. The average period in hospital of recovery cases was: civilian cases forty-five days, military cases sixty-six days. Since the opening of a military carrier centre at Sutton-Veny and the transference to this centre of military cases on convalescence, the duration of the stay in hospital of military cases has been reduced, as in 1915 and 1916 military patients were retained in hospital until two successive negative throat swabs were obtained.

Treatment.—I do not think that drugs have any specific action. In the earlier cases (1915), in addition to lumbar punctures and serum, many drugs were tried, soamin, urotropine, neosalvarsan, and potassium iodide, without apparently any decided influence on the course of the disease in various cases, and their use has been discontinued. For the relief of headache and sleeplessness morphia, morphia and atropin, heroin, bromide and chloral, were successful; aspirin was very beneficial in the milder cases. In the severe forms, morphia and heroin were given freely with satisfactory results. Saline solution given per rectum or intravenously, always did good. Brandy was necessary in many cases. Pituitary extract and ether were found preferable to strychnine. Hot saline baths and hot sponging were used a good deal and were found most useful, relieving restlessness and headache, lowering the body temperature and promoting sleep. Lumbar puncture is essential, both as regards diagnosis and

treatment; I have used Barker's needles and canulas, no syringe being used to withdraw fluid.

Serum Treatment.—The result of serum administration in the earlier cases was unsatisfactory, in fact the use of it was discontinued for a time. From April to October, 1915, Flexner's serum was used with fairly good results. During 1916 and 1917 reliance has been chiefly placed on lumbar puncture and the administration of serum. The Lister Institute serum has been employed for military cases, with a few exceptions. For civilian cases, "Burroughs Wellcome" and "Mulford" sera have been employed. In the severest cases, in addition to intrathecal doses, serum has been given intravenously, with saline solution. The administration of adrenalin, ten minims every four hours, hypodermically for twenty-four hours, in cases with purpuric rashes and also for hæmaturia, has given very promising results.

In some cases the result of serum seemed remarkable, and in my opinion, with serum-treated cases, there is more rapid recovery in severe cases, and less likelihood of relapses and sequelæ. The serum is warmed before use and allowed to run in by gravity through the canula with funnel and tubing, the amount of the dose being determined by the amount of the cerebrospinal fluid withdrawn. I think it is advisable never to insert as much serum as cerebrospinal fluid withdrawn, forty to fifty cubic centimetres being a maximum dose at one administration for an adult. Chloroform was the anæsthetic usually given when necessary for lumbar punctures. I have not seen any reason to abstain from giving an anæsthetic in these cases; where serum is to be administered it is better given under an anæsthetic. In the severe cases with rigidity, it is often impossible to puncture without an anæsthetic. In mild cases, where no serum was to be administered, or simply for diagnostic purposes, it was generally quite easy to puncture without an anæsthetic.

Nursing.

The importance of skilled nursing in cases of cerebrospinal fever cannot be overrated and the recovery of several of our patients must be attributed to the constant care and attention they received from the matron and nursing staff of the hospital.

Direct Infection.

The following cases are examples of direct infection:—

(1) F. R., aged 3½ years, was admitted to hospital on February 10, 1915, with a history of one day's illness. L. R., aged 3½, a twin brother of F. R., was admitted on the same day, February 10, 1915, with a history of five days' illness. Both had occupied the same bed; both died.

(2) E. D., aged 27, was admitted to the hospital January 16, 1915, with a history of a few hours' illness; ten days later, her mother, Mrs. D., was admitted, and on the same day the *fiancé* of E. D., a Canadian corporal, was admitted into a military hospital, suffering from cerebrospinal fever. Mrs. D. and the corporal were present when E. D. was removed, and both of them may have kissed or embraced her. All these cases proved fatal.

(3) A little boy, B. H., aged 5 years, died after a very brief illness on December 30, 1916. He was found to be suffering from cerebrospinal fever. On December 31, 1916, A. H. (brother of B. H.), aged 7 years, was admitted to hospital suffering from cerebrospinal fever. He recovered. The brothers had been sleeping together.

During 1917 investigations regarding the type of meningococcus found in military cases were undertaken by the bacteriologists of the Military Hospital, Sutton-Veny. In addition to the positive cases, there were admitted, with symptoms suggesting cerebrospinal fever, 141 cases. Of these, twenty were civilian and 121 military cases. The larger number of military cases may be due to the fact that soldiers with symptoms suggesting cerebrospinal fever are at once sent to hospital. In the civilian cases, as a rule, the disease is fairly definite on admission. Mild cases of cerebrospinal fever in civilians may possibly be overlooked, and if this be so, probably the apparently higher recovery rate of the military positive cases may be attributed to this cause. The ultimate diagnosis of twenty civilian cases admitted as (?) cerebrospinal fever and found not to be cases of the disease was as follows: Influenza, 5; pneumonia, 7; bronchitis, 1; gastro-enteritis, 1; hysteria, 1; tubercular meningitis, 2; tonsillitis, 1; cerebral tumour, 1; poliomyelitis, 1.

In all cases, excepting the two cases of tubercular meningitis, the cerebrospinal fluid was clear, and nothing was found on examination. The final diagnosis of 121 military cases admitted as (?) cerebrospinal fever in which the original diagnosis was not confirmed were as follows: Influenza, 40; sunstroke, 3; concussion of brain and spine, 4; dental caries, 1; dilated heart, 1; epilepsy, 3; pneumonia and broncho-pneumonia, 13; scarlet fever, 4; tonsillitis, 5; otitis, 2; pericarditis, 1; appendicitis, 1; measles, 3; malaria, 1; loss of memory, 1; myalgia, 4; renal disease, 3; cerebrospinal fever contact, 1; bronchitis, 7; vaccinia, 5; gastritis, 2; neuralgia, 2; rheumatism, 5; anti-typhoid inoculation 5; headache, 3.

Dr. Ord has kindly allowed me to give particulars relating to eighteen of the earlier cases who were under his care at the Salisbury Infirmary.

I must also express my thanks to my colleagues in Salisbury for their assistance in administering anæsthetics when necessary, and also to the bacteriologists of the Military Hospital, Sutton-Veny.

Reviews.

ROLL OF COMMISSIONED OFFICERS IN THE MEDICAL SERVICE OF THE BRITISH ARMY. By the late Colonel William Johnston, C.B. Aberdeen: University Press. 1917. Pp. lxxii and 638. $10\frac{1}{4} \times 7\frac{3}{4}$.

To many of the older officers of the Royal Army Medical Corps this volume has an interest apart from its avowed object, in that it was a labour of love on the part of a well-known, highly and justly esteemed officer of the Corps, to whom we owe much more than most of us recognize, even those with some fragments of knowledge on the subject.

The personal note contributed by Sir William Babtie, V.C., with the bibliography of Johnston's work, explains why his memory is so respected—for his personal qualities and for the work he did.

The Roll covers the period June, 1727, to June, 1898, and it is of course essential for the proper understanding of the Roll itself, that some account should be given of the vicissitudes of the Medical Services of the Army at various times. This is naturally technical to a considerable degree and not very easy reading, but one has the impression that part of this ground has been surveyed—more in outline—by other authors in previous articles; if not, it appears desirable that Lieutenant-Colonel H. A. L. Howell should supply such a sketch, for which there is no one better qualified. The development to its present stage of the

Royal Army Medical Corps is now more than a Corps concern; and something to be read and understood by the general public would be of exceptional interest. There is, of course, a good deal about one period (not the least interesting) in the life of Florence Nightingale—probably that period of the Nineteenth Century at which the greatest stimulus was given. But for the older men Colonel Johnston's account revives memories of old contests, old controversies, many of which now seem trivial, though all were stages in evolution.

Of the Roll itself it is difficult to speak except in recognition of the ability, labour and determination necessary for its compilation. It happens that the volume opened casually at pp. 322, 323, i.e., 1842-43, and the name of Sir Thomas Longmore appears under 1843, the first on the Roll of those whom the reviewer knew personally, though Edmund Alexander Parkes and Sir William Muir are known to many—one as a leader in modern hygiene and the other as a great Director-General. As the Roll goes on—one's personal acquaintances (from a very humble position) increase very slowly, but the known names rapidly, till one reaches the period when the men one served under appear—and memories of companionship and occasional antagonism arise. Recollections of old stories, and the thousand and one incidents of one's life, revive—it suggests the tension of the Day of Judgment, which cannot be unmixed with Homeric laughter unless a sense of humour is essentially a bodily quality.

The pity of it is that no young officer can get the full value of the book, though every one should see what his predecessors have done. After all there were brave men before Agamemnon.

The book has been ably edited by Lieutenant-Colonel Howell, who shows how the work, incomplete at the time of Colonel Johnston's death, was carried on by his hands and by Colonel Peterkin, C.B., with assistance from others named.

Every Royal Army Medical Corps Mess and Library, and all Service Clubs should possess this Roll. R. J. S. S.

The Fitting Out and Administration of a Naval Hospital Ship. By Fleet Surgeon E. Sutton, R.N. Published by John Wright and Sons, Ltd., Bristol, 1918. Price 8s. Pp. vi + 110, $5\frac{3}{8} \times 8\frac{1}{2}$.

This small book on fitting out and administration of a Naval Hospital Ship is divided into four sections. Section I is historical and also gives International Law relating to hospital ships and the Geneva Convention. Section II gives in detail the conversion and fitting out of a typical hospital ship. These two sections are an excellent summary and guide on the points to which they refer.

Sections III and IV, comprising more than half the book, give details of organization. The embarkation and disembarkation routine are fully described as regards naval routine. As the rest of the book is applicable to hospital ships of the Army as well as the Navy, it is a pity that the Army routine of embarkation, disembarkation and distribution of the patients to various hospitals is not given, as it would have made the book of more general value.

Elements of Field Hygiene and Sanitation. By Joseph H. Ford, B.S., A.M., M.D., Colonel, Medical Corps U.S. Army. London: William Heinemann, Ltd. 1918. Pp. 248, with Index. 8vo. Price 6s. net.

This book is a very useful addition to the library of practical war sanitation. Some of the methods and illustrations have been taken from Lelean's "Sanitation in War," but there is also much that is new. The last chapter on illustrative regulations concerning field hygiene and sanitation are worth issuing to every officer and senior N.C.O. in all Allied armies. The diagrams of constructional details at the end of the book should find a place in the Field Service Pocket Book.

The general text of the book is written to be understood by the combatant officer, and is full of practical suggestions. The work should be of considerable assistance to the sanitary officer in preparing lectures and giving instruction to effective troops. Photographs and diagrams are clear and well reproduced; the subject matter is well printed.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

July, 1918.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
May 18, 1918.

The Government of India has forwarded the following list of Officers, whose names have been brought to notice by Lieut.-Gen. Sir A. A. Barrett, K.C.B., K.C.S.I., K.C.V.O., for valuable services rendered during the operations against the Mahsuds, March—August, 1917 :—

MEDICAL SERVICES.

Lieut.-Col. L. Addams-Williams, Royal Army Medical Corps.
Lieut.-Col. P. H. Faulkner, Royal Army Medical Corps.
Capt. J. M. Weddell, Royal Army Medical Corps.

War Office,
May 20, 1918.

The following despatch has been received by the Secretary of State for War from Field-Marshal Sir Douglas Haig, K.T., G.C.B., G.C.V.O., K.C.I.E., Commander-in-Chief of the British Armies in France :—

General Headquarters,
April 7, 1918.

My Lord,—I have the honour to submit the names of the Officers, serving, or who have served, under my command during the period September 25, 1917, to midnight, February 24/25, 1918, whose distinguished and gallant services and devotion to duty I consider deserving of special mention.

I have the honour to be, my Lord,
Your obedient Servant,
D. HAIG, *Commander-in-Chief,*
The British Armies in France.

STAFF.

Major and Brevet Lieut.-Col. E. Ryan, D.S.O., Royal Army Medical Corps.

War Office,
May 13, 1918.

His Majesty the King has been graciously pleased to approve of the following awards to the undermentioned Officers, in recognition of their gallantry and devotion to duty in the Field :—

AWARDED THE MILITARY CROSS.

Temp. Qmr. and Hon. Lieut. Robert Leslie Masters, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when a camp and some billets were heavily shelled by the enemy. He at once went to the rescue of some men who had been buried in the ruins of a house, and rendered first-aid. He then organized bearer parties from among his men, and brought in four severely wounded men from the camp. By his disregard of danger, quick decision, and good leadership, he set a splendid example to his men, and rendered valuable assistance to the wounded in the absence of a medical officer.

Temp. Capt. Henry Drummond Robb, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. On his camp and its vicinity being heavily shelled he was compelled to conduct his sick parade along the roads which were at the time under heavy shell fire. He succeeded in leading his wounded cases safely under cover, and later remained behind to attend to the men of a neighbouring unit, which had also suffered some casualties as a result of the intense shelling. His courage and devotion to duty were of the highest order.

Temp. Capt. Samuel Rutherford, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During a period of sixteen hours he tended the wounded in the front trenches without ceasing. Throughout this period he was exposed to heavy shell fire, and for some considerable time the enemy were within a short distance of the aid post. His coolness and presence of mind inspired all ranks with the utmost confidence.

MENTIONS IN DISPATCHES.

Mesopotamia.

War Office,
May 11, 1918.

The following names are added to the list of Officers, Warrant and Non-commissioned Officers and Men, Ladies and Civilians whose services have been brought to notice as deserving of special mention by the late Lieut.-Gen. Sir Stanley Maude, K.C.B., Commander-in-Chief, Mesopotamian Expeditionary Force, in his dispatch (published in the *London Gazette*. No. 30233, dated August 15, 1917) :—

Capt. A. J. Evans, F.R.C.S.Edin., Royal Army Medical Corps (T.F.).
Temp. Capt. A. T. Gibb, Royal Army Medical Corps.

CORRIGENDA TO "MENTIONS IN DISPATCHES."

Egypt.

Under Royal Army Medical Corps (p. 802) :—
No. 29380 Cpl. (Acting Serjt.) J. E. Aynsley.

Mesopotamia.

Supplement to the *London Gazette*, No. 29810, dated November 1, 1916. Under Royal Army Medical Corps (p. 10618) :—
Temp. Hon. Capt. W. R. Thomas, Royal Army Medical Corps.

Supplement to the *London Gazette*, No. 30570, dated March 12, 1918. The name of the undermentioned should read as now stated, and not as previously published. Under Royal Army Medical Corps (p. 3117) :—
No. 25648 Serjt. J. H. Jones.

War Office,
May 25, 1918.

The following is a continuation of Sir D. Haig's dispatch of April 7, submitting names deserving of special mention :—

ARMY MEDICAL SERVICE.

Headquarters Staff.

Lieut.-Gen. Sir A. T. Sloggett, K.C.B., K.C.M.G, K.C.V.O., F.R.C.S., K.H.S.
Major-Gen. C. H. Burtchaell, C.B., C.M.G., M.B.
Major-Gen. Sir W. G. Macpherson, K.C.M.G., C.B., M.B., K.H.P.
Temp. Capt. J. Biggam, M.B., Royal Army Medical Corps.
Major R. B. Black, D.S.O., M.B. (Reserve of Officers), Royal Army Medical Corps.
Lieut.-Col. W. R. Blackwell, Royal Army Medical Corps.
Capt. L. G. Bourdillon, D.S.O., M.C., Royal Army Medical Corps.
Col. H. A. Bray, C.M.G., Royal Army Medical Corps.
Capt. A. D. Child, M.B., Royal Army Medical Corps (Special Reserve).
Col. R. W. Clements, D.S.O., M.B.
Lieut.-Col. (Temp. Col.) H. Collinson, D.S.O., M.B., F.R.C.S., Royal Army Medical Corps.
Major (Acting Lieut.-Col.) P. Davidson, C.M.G., D.S.O., M.B., Royal Army Medical Corps.
Capt. K. K. Drury, M.C., M.D., Royal Army Medical Corps (Special Reserve).
Capt. T. I. Dunn, M.C., M.B., Royal Army Medical Corps (Special Reserve).
Temp. Capt. M. du B. Ferguson, M.D., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) R. S. H. Fuhr, C.M.G., D.S.O., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) J. S. Gallie, D.S.O., Royal Army Medical Corps.
Lieut.-Col. and Brevet Col. (Temp. Col.) T. W. Gibbard, M.B., K.H.S., Royal Army Medical Corps.
Temp. Capt. R. E. Gibson, M.B., Royal Army Medical Corps.
Lieut.-Col. T. A. Granger, M.B., Indian Medical Service.
Temp. Capt. S. S. Greaves, M.C., Royal Army Medical Corps.
Lieut. Col. (Temp. Col.) J. Grech, D.S.O., Royal Army Medical Corps.

Capt. A. H. Heslop, D.S.O., M.B., Royal Army Medical Corps.
Lieut.-Col. H. C. R. Hime, D.S.O., M.B., Royal Army Medical Corps.
Col. W. E. Hudleston, D.S.O.
Lieut.-Col. (Temp. Col.) L. Humphry, C.M.G., Royal Army Medical Corps.
Temp. Capt. H. G. Kilner, M.B., Royal Army Medical Corps.
Col. Sir W. B. Leishman, C.B., F.R.S., M.B., F.R.C.P., K.H.P.
Major (Temp. Col.) C. H. Lindsay, C.M.G., M.D., Royal Army Medical Corps.
Capt. J. G. McCutcheon, M.B., Royal Army Medical Corps (Special Reserve).
Col. S. Macdonald, C.B., C.M.G., M.B.
Lieut.-Col. and Brevet Col. A. J. Macnab, F.R.C.S., Indian Medical Service.
Lieut.-Col. J. F. Martin, C.M.G., M.B.
Col. F. J. Morgan, C.M.G.
Lieut.-Col. (Temp. Col.) E. M. Morphew, D.S.O., Royal Army Medical Corps.
Col. D. M. O'Callaghan, C.M.G.
Surg.-Gen. M. W. O'Keeffe, C.B., M.D.
Lieut.-Col. (Temp. Col.) G. J. A. Ormsby, M.D., D.S.O., Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) E. T. Potts, D.S.O., M.D., Royal Army Medical Corps.
Temp. Capt. G. Rankine, M.C., M.B., Royal Army Medical Corps.
Col. (Temp. Surg.-Gen.) B. M. Skinner, C.B., C.M.G., M.V.O.
Capt. O. W. D. Steel, M.C., Royal Army Medical Corps.
Col. G. St. C. Thom, C.M.G., M.B.
Lieut.-Col. (Temp. Col.) A. G. Thompson, D.S.O., M.B., Royal Army Medical Corps.
Major-Gen. H. N. Thompson, C.B., C.M.G., D.S.O., M.B.
Capt. L. R. Tosswill, Royal Army Medical Corps.
Capt. L. R. Turner, Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) D. P. Watson, M.B., Royal Army Medical Corps.
Temp. Capt. R. H. G. Weston, M.B., Royal Army Medical Corps.

Consultants.

Major (Temp. Lieut.-Col.) H. A. Ballance, M.D., F.R.C.S.
Temp. Major-Gen. Sir A. A. Bowlby, K.C.M.G., K.C.V.O., F.R.C.S.
Temp. Major-Gen. Sir J. R. Bradford, K.C.M.G., C.B., F.R.S., M.D
Major R. H. Cooper, Royal Army Medical Corps.
Temp. Major-Gen. Sir B. E. Dawson, G.C.V.O., C.B., M.D.
Major (Temp. Col.) H. McI. W. Gask, C.B., M.B., F.R.C.S.
Major (Temp. Col.) H. McI. W. Gray, C.B., M.B., F.R.C.S.
Col. E. M. Pilcher, D.S.O., M.B., F.R.C.S.
Temp. Col. O. W. Richards, D.S.O., M.D., F.R.C.S.
Temp. Col. T. Sinclair, C.B., F.R.C.S.
Lieut-Col. (Temp. Col.) C. B. Thorburn, C.B., M.D., F.R.C.S.
Temp. Major-Gen. C. S. Wallace, C.M.G.
Capt. (Temp. Col.) A. E. Webb-Johnson, D.S.O., M.B., F.R.C.S.
Temp. Col. Sir A. E. Wright, C.B., M.D., F.R.C.S.I., F.R.S.

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. J. Alexander, M.B.
Temp. Capt. A. S. K. Anderson, D.S.O., M.C., M.B.
Temp. Capt. J. S. Arkle, M.B.
Qmr. and Hon. Major H. J. F. Audus.
Temp. Capt. C. C. Austen.
Temp. Capt. T. B. Batchelor.
Qmr. and Temp. Lieut. V. A. Bell.
Temp. Capt. W. C. Blackham, M.B.
Temp. Capt. A. D. Blakeley, M.B.
Capt. (Acting Lieut.-Col.) W. W. Boyce.
Temp. Capt. C. F. Brady, M.B.
Temp. Qmr. and Hon. Capt. B. G. Brook.
Temp. Capt. G. M. Brown, M.B.
Major (Acting Lieut.-Col.) C. G. Browne, D.S.O.
Qmr. and Hon. Major E. J. Buckley.
Temp. Hon. Lieut.-Col. H. Cabot.
Temp. Capt. J. P. Cahir, M.B.
Temp. Capt. S. B. B. Cambell, M.B.
Temp. Capt. T. H. Cambell, M.B.
Temp. Capt. H. M. B. Caplan.
Temp. Capt. F. F. Carr-Harris, D.S.O., M.D.
Temp. Capt. M. T. Cassidy, M.B.
Temp. Capt. A. W. S. Christie, M.B.
Temp. Lieut. J. S. Clark, M.B.
Capt. (Acting Lieut.-Col.) C. Clarke, M.B., F.R.C.S.
Temp. Capt. C. J. W. Clayton.
Major T. S. Coates, M.B.
Temp. Capt. C. G. Colyer.
Temp. Capt. J. A. Conway, M.C., M.D.
Major R. H. Cooper.
Temp. Capt. G. M. Cowper.
Temp. Capt. W. Crabtree, M.B.
Temp. Capt. J. Crawford, M.C.
Qmr. and Hon. Capt. F. C. Cross.
Temp. Capt. J. M. D. Cruickshank.
Capt. (Temp. Lieut.-Col.) F. W. M. Cunningham, M.D.
Major (Acting Lieut.-Col.) J. Dalrymple.
Temp. Lieut.-Col. C. G. Douglas, M.C., M.D.
Temp. Capt. (Acting Lieut.-Col.) R. E. Drake-Brockman.
Lieut. (Temp. Capt.) C. R. Dudgeon, M.C.
Temp. Lieut.-Col. (Lieut.-Col., Aust.A.M.C.), W. J. E. Eames, C.B., M.D.
Temp. Capt. G. D. Eccles.
Temp. Capt. J. A. Edmund.

Temp. Capt. H. Emerson, M.C., M.B.
Qmr. and Hon. Capt. C. A. Figg.
Temp. Capt. C. C. Forsyth.
Temp. Capt. D. S. Graham.
Temp. Capt. H. B. Graham, D.S.O., M.B.
Temp. Capt. A. Gray, M.D.
Major (Acting Lieut.-Col.) G. D. Gray, M.D.
Qmr. and Hon. Major J. Green.
Major (Temp. Lieut.-Col.) R. C. Hallowes, M.B.
Lieut.-Col. A. E. Hammerton, D.S.O.
Temp. Capt. C. Harris.
Lieut.-Col. (Temp. Col.) J. A. Hartigan, D.S.O.
Major (Temp. Lieut.-Col.) T. E. Harty, D.S.O.
Major (Temp. Lieut.-Col.) W. J. S. Harvey, D.S.O.
Capt. (Acting Lieut.-Col. R. Hemphill, M.B.
Temp. Capt. F. W. Hird, M.B.
Major J. E. Hoar.
Temp. Qmr. and Hon. Capt. T. W. Jent.
Temp. Capt. L. C. Johnson.
Temp. Capt. (Acting Lieut.-Col.) A. Jones, M.C., M.D.
Temp. Capt. W. D. Kennedy, M.B.
Temp. Qmr. and Hon. Lieut. E. Kerstein, M.C.
Temp. Hon. Major L. F. B. Knuthsen, R.A.M.C.
Temp. Capt. P. J. Lane, M.C., M.B.
Temp. Capt. R. M. Lang, M.B.
Qmr. and Hon. Lieut. H. B. Lee.
Temp. Capt. R. D. Lemon, M.B.
Temp. Qmr. and Hon. Lieut. P. le Poidevin.
Major (Acting Lieut.-Col.) R. P. Lewis.
Temp. Capt. G. A. Lilly.
Temp. Capt. S. J. L. Lindeman.
Temp. Capt. W. H. Lister, D.S.O., M.C.
Temp. Capt. A. L. Lockwood, M.C. M.D.
Major J. L. London, M.B.
Temp. Capt. P. A. MacCullum, M.B.
Temp, Capt. S. E. McClatchly, M.B.
Temp. Capt. J. W. Macfarlane, M.C., M.B.
Temp. Capt. R. McGrath, M.B.
Temp. Qmr. and Hon. Lieut. J. B. Mackay.
Temp. Capt. R. A. MacNeill, M.B.
Temp. Capt. A. C. B. McMurtrie, F.R.C.S., M.D.
Temp. Capt. W. R. P. McNeight, M.D.
Capt. (Acting Lieut.-Col.) A. N. R. McNeill, M.B.
Temp. Lieut.-Col. A. Martin-Leake, V.C., F.R.C.S.
Temp. Capt. A. F. Mavety, M.B.
Temp. Qmr. and Hon. Lieut. H. Miller.
Temp. Capt. D. M. Morison, M.B.
Temp. Capt. J. Morrison, M.B.
Temp. Capt. H. H. P. Morton.
Capt. W. P. Mulligan. M.B.
Capt. W. G. Mumford, M.B., F.R.C.S.
Major (Acting Lieut.-Col.) C. D. Myles, M.B.
Temp. Capt. G. E. Nicholls, M.B.
Capt. (Acting Lieut.-Col.) T. B. Nicholls, M.B.
Temp. Hon. Capt. H. Nockolds, M.B.
Capt. (Acting Lieut.-Col.) J. J. O'Keeffe, M.C., M.B.
Major (Temp. Lieut.-Col.) A. C. Osburn, D.S.O.
Qmr. and Hon. Capt. (Acting Major) J. T. Packard.
Capt. E. Phillips, M.C., M.B.
Temp. Capt. F. E. L. Phillips.
Temp. Capt. J. G. Pigott.
Lieut.-Col. J. Powell, M.B.
Temp. Capt. J. A. Pringle, M.D.
Temp. Capt. J. Proctor, M.B.
Temp. Capt. (Temp. Lieut.-Col.) C. D. Pye-Smith, D.S.O., M.C., F.R.C.S., M.B.
Temp. Capt. C. R. Reckitt.
Temp. Capt. G. W. Riddel, M.B.
Temp. Capt. A. C. Rowswell, M.B.
Capt. (Acting Lieut.-Col.) C. Scaife, M.D.
Temp. Capt. C. Scales, M.D.
Qmr. and Hon. Capt. E. B. Senior.
Temp. Capt. (Acting Lieut.-Col.) L. D. Shaw, D.S.O., M.B.
Major (Acting Lieut.-Col.) H. C. Sidgwick, M.B.
Major M. Sinclair, M.B.
Temp. Qmr. and Hon. Lieut. E. B. Snowden
Qmr. and Hon. Lieut. E. B. Steele.
Major (Acting Lieut.-Col.) W. L. Steele.
Temp. Lieut.-Col. G. N. Stephen.
Temp. Capt. D. S. Taylor.
Major (Acting Lieut.-Col.) C. H. Turner, D.S.O.
Temp. Capt. G. W. Twigg, M.D.
Major (Acting Lieut.-Col.) T. B. Unwin, M.B.
Capt. (Acting Lieut.-Col.) E. W. Wade, M.B.
Temp. Capt. W. Warburton, M.B.
Major (Acting Lieut.-Col.) W. J. Waters.
Capt. W. L. Webster, M.B.
Temp. Capt. W. W. Wells, M.B.
Temp. Capt. C. R. Whittaker, F.R.C.S.
Temp. Capt. D. R. Williams.
Temp. Capt. R. L. Williams, M.C.
Qmr. and Hon. Capt. F. Wilson.
No. 77055 Serjt. G. W. Ames.
No. 339026 Serjt. C. Atherton.
No. 19336 Cpl. (Acting Staff-Serjt.) A. Barnes.
No. 13338 S. M. Boxhall, H.S.
No. 42527 Pte. (Acting Cpl.) R. H. Bradbury.
No. 71956 Pte. (Acting Serjt.) J. W. Briggs.
No. 16756 Staff-Serjt. (Acting Qmr.-Serjt.) N. W. Brown.
No. 40423 Pte. (Acting Serjt.) F. J. Burgess.
No. 62700 Serjt. F. E. Buxton.
No. 18061 Staff-Serjt. (Acting Serjt.-Major) W. Cairns.
No. 48925 Pte. (Acting Cpl.) A. Channing.
No. 48097 Pte. A. E. Chave.
No. 61883 Cpl. (Acting Serjt.) E. G. Clegg.
No. 38125 Cpl. (Acting Serjt.) A. C. Darbyshire.
No. 65323 Pte. (Acting Serjt.) D. T. Davidson.
No. 27943 Pte. A. Dickinson.
No. 53674 Cpl. (Acting Qmr.-Serjt.) H. Duke.
No. 90487 Pte. (Acting Cpl.) S. A. Dyer.
No. 77071 Pte. (Acting Serjt.) H. Evans.
No. 19688 Staff-Serjt. (Acting Serjt.-Major) T. V. Falkingham.
No. 15312 Serjt. G. Gillespie.
No. 54843 Cpl. R. B. Graham.
No. 71738 Pte. T. Hacking.
No. 89674 Pte. J. Hadfield.
No. 17212 Pte. (Acting Cpl.) F. Haskell.
No. 90454 Staff-Serjt. A. Hay.
No. 63912 Serjt. (Acting Staff-Serjt.) D. Jeffreys.
No. 48311 Serjt. G. J. Jones.
No. 54078 Serjt. (Acting Qmr.-Serjt.) W. Keighley.
No. 54640 Serjt. (Acting Qmr.-Serjt.) H. Kirwan.
No. 1659 Pte. (Acting Cpl.) J. Loram.

No. 17632 Qmr.-Serjt. H. C. A. Lunn.
No. 45969 Serjt. G. Mackay.
No. 32950 Pte. T. McWhannel.
No. 54443 Serjt. H. Mellor.
No. 320119 Cpl. A. Mennie.
No. 16397 Staff-Serjt. W. G. Mills.
No. 46711 Pte. J. Monaghan.
No. 640 Pte. A. Nixon.
No. 1278 Pte. I. Parker.
No. 75280 Serjt. S. R. Paskin.
No. 19126 Serjt. (Acting Serjt.-Major) F. H. Perkins.
No. 10031 Pte. W. Penman.
No. 32964 Serjt. (Acting Staff-Serjt.) F. E. Preston.
No. 41193 Pte. J. Rainey.
No. 59112 Pte. (Acting Cpl.) L. Richards.
No. 69111 Pte. (Acting Cpl.) M. H. Rowe.
No. 37022 Cpl. J. Simpson.
No. 76432 Cpl. (Acting Lance-Serjt.) W. C. Smith.
No. 8861 Serjt. E. Steffens.
No. 5731 Pte. (Acting Cpl.) T. Thorne.
No. 2276 Pte. (Acting Cpl.) D. Torrance.
No. 35182 Pte. H. Stansfield.
No. 15967 Serjt. W. T. Tringham.
No. 58655 Cpl. F. Turner.
No. 5134 Serjt. A. Vaughan.
No. 72533 Pte. (Acting Lance-Cpl.) F. A. Watson.
No. 90437 Pte. (Acting Lance-Cpl.) J. E. Williams.
No. 12185 Staff-Serjt. (Acting Qmr.-Serjt.) A. S. Willis.

ROYAL ARMY MEDICAL CORPS.

Capt. W. R. Blore, M.B.
Capt. C. F. Burton.
Capt. W. B. Cathcart, M.B.
Capt. E. M. Cowell, M.D., F.R.C.S.
Capt. T. G. Fleming, M.C., M.B.
Capt. F. H. Goss, M.B.
Capt. R. A. Greenwood, M.B.
Capt. (Acting Lieut.-Col.) C. J. A. Griffin.
Capt. T. F. Hegerty, M.B.
Capt. F. Jefferson, M.B.
Capt. J. I. Lawson, M.B.
Capt. W. McK. H. McCullagh, D.S.O., M.C., M.B.
Capt. (Acting Lieut.-Col.) S. Miller, M.C., M.B.
Capt. G. H. C. Mold, M.B.
Capt. (Acting Lieut.-Col.) K. D. Murchison, D.S.O., M.B.
Capt. C. M. Page, M.B., F.R.C.S.
Capt. (Acting Lieut.-Col.) A. T. Pitts.
Capt. (Acting Lieut.-Col.) E. T. C. Robertson, D.S.O., M.B.
Capt. H. G. Trayer, M.B.

ROYAL ARMY MEDICAL CORPS (T.F.).

Capt. J. W. Anderson, M.C., M.B.
Capt. C. F. Backhouse.
Major T. A. Barron.
Major (Temp. Lieut.-Col.) E. B. Bird, D.S.O.
Capt. (Acting Lieut.-Col.) W. Blackwood, M.B.
Temp. Capt. L. Blake, M.B.
Qmr. and Hon. Capt. C. W. Braithwaite
Capt. (Temp. Lieut.-Col.) J. Bruce, M.B.
Capt. F. G. Caley, M.B.
Major (Acting Lieut.-Col.) A. Callam, M.B.
Capt. O. Cattlin.
Capt. J. W. Dale, M.B.
Capt. (Acting Lieut.-Col.) F. G. Dobson, M.B.
Capt. (Temp. Lieut.-Col.) C. W. Eames, M.D.
Lieut.-Col. W. E. Foggie, M.D.
Capt. and Brevet-Major (Temp. Lieut.-Col.) C. H. S. Frankau, M.B., F.R.C.S.
Capt. H. N. Goode, M.B., F.R.C.S.
Capt. J. M. Hamill.
Capt. T. R. Kenworthy, M.C.
Capt. G. C. King.
Capt. G. H. Kirby.
Capt. (Temp. Major) E. Knight, M.B.
Capt. (Acting Lieut.-Col.) C. L. Lander, M.C., M.B.
Capt. (Acting Lieut.-Col.) H. B. Low, M.C., M.D.
Capt. (Acting Lieut.-Col.) Mackie.
Capt. (Acting Lieut.-Col.) J. MacMillan, M.C., M.B.
Capt. S. A. S. Malkin.
Capt. A. C. Mallace, M.B.
Major (Temp. Lieut.-Col.) J. Nightingale, M.D.
Capt. R. P. Pollard, M.B.
Qmr. and Hon. Lieut. T. Priest.
Capt. H. H. Robinson, M.C.
Capt. F. E. W. Rogers.
Capt. S. Scott, M.B.
Capt. J. M. Smith, M.B.
Major (Temp. Lieut.-Col.) C. A. A. Stidston D.S.O., M.D.
Capt. W. Stobie, M.B.
Major (Temp. Lieut.-Col.) W. G. Sutcliffe, F.R.C.S.
Capt. A. C. Watkin.
Capt. (Acting Lieut.-Col.) A. J. Williamson, M.D.
Major (Temp. Lieut.-Col.) P. G. Williamson, M.C., M.B.
No. 435439 Pte. F. Bayman.
No. 527013 Staff-Serjt. H. Body.
No. 405272 (Acting Cpl.) W. Briggs.
No. 536010 Serjt. F. Burridge.
No. 493723 Cpl. W. Chick.
No. 412002 Staff-Serjt. L. H. Clarke.
No. 305012 Serjt. J. R. Crabbe.
No. 337283 Serjt.-Major F. Fowles.
No. 403176 Pte. H. B. Garlick.
No. 461344 Cpl. C. R. Garrett, M.M.
No. 495191 Staff-Serjt. P. W. Glover.
No. 527784 Acting Serjt. F. A. Green
No. 461281 Serjt. (Acting Staff-Sergt.) H. H. Hayward.
No. 546228 Pte. C. E. Laugham.
No. 403650 Pte. E. McWilliams.
No. 417083 Cpl. A. Moran.
No. 386014 Qmr.-Serjt. (Temp. Serjt.-Major) P. T. Pickard.
No. 497317 Serjt. (Acting Staff-Serjt.) E. R. Ridley.
No. 339033 Serjt. (Acting Staff-Serjt.) A. Sandham.
No. 350236 Serjt. D. Shirt.
No. 512323 Serjt. W. C. S. Smither.
No. 426123 Pte. H. Walkerdine.
No. 527209 Pte. (Acting Cpl.) V. C. Wheeler.

War Office,
May 30, 1918.

The following dispatch has been received by the Secretary of State for War from General Sir Herbert Plumer, G.C.B., G.C.M.G., G.C.V.O., A.D.C. :—

Headquarters,
April 18, 1918.

My Lord,—I have the honour to submit a list of names of these officers, non-commissioned officers, and men, serving, or who have served, under my Command, whose distinguished and gallant services and devotion to duty I consider deserving of special mention,

I have the honour to be, My Lord,
Your obedient Servant,
Herbert Plumer, *General.*

Army Medical Service.

Staff.

Col. R. J. Blackham, C.M.G., C.I.E., D.S.O., M.D.
Col. S. L. Cummins, C.M.G., M.D., Royal Army Medical Corps.
Col. J. V. Forrest, C.M.G., Royal Army Medical Corps.
Lieut.-Col. C. H. Furnivall, Royal Army Medical Corps.
Capt. T. D. Inch, M.C., M.B., Royal Army Medical Corps.
Col. L. N. Lloyd, C.M.G., D.S.O., Royal Army Medical Corps.
Major-Gen. F. R. Newland, C.B., C.M.G., M.B.
Temp. Capt. W. J. Pearson, M.C., M.B., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) R. Pickard, C.M.G., M.B., Royal Army Medical Corps.
Col. T. du B. Whaite, C.M.G., M.B.

Royal Army Medical Corps.

Temp. Qmr. and Hon. Lieut. E. G. I. Brice.
Temp. Capt. W. E. Bullock, M.D.
Temp. Capt. P. J. Chissell.
Lieut.-Col. W. C. Croly.
Temp. Capt. S. J. Drake, M.C., M.B.
Temp. Capt. J. S. Davies.
Capt. D. G. Duff, M.B. (Special Reserve).
Temp. Capt. J. S. Doyle.
Temp. Capt. W. Duffy, M.B.
Temp. Qmr. and Hon. Lieut. C. Elliot, M.C.
Temp. Capt. D. G. Gardiner, M.B.
Temp. Qmr. and Hon. Lieut. T. H. Griggs.
Capt. (Acting Lieut.-Col.) A. Irvine-Fortescue, M.B.
Temp. Lieut. T. B. Johnston, M.B.
Lieut. (Temp. Capt.) T. J. Kelly, M.C.
Temp. Capt. T. L. Llewellyn, M.D.
Capt. H. W. Maltby (Special Reserve).
Capt. T. S. Nelson (Special Reserve).
Capt. (Temp. Lieut.-Col.) T. H. Scott, M.C., M.B.
Temp. Capt. T. Stordy.
Temp. Capt. T. Thompson.
Temp. Capt. H. Upcott.
Temp. Capt. R. R. Watts, M.B.
Lieut.-Col. J. W. West, M.B.
No. 295 Staff-Serjt. A. E. Cheer.
No. 4724 Pte. H. F. Davey.
No. 28385 Serjt. W. Greenwood.
No. 100910 Pte. (Acting Lance-Cpl.) J. Harte.
No. 83038 Pte. (Acting Cpl.) J. W. Hindley.
No. 10634 Serjt. (Acting Qmr.-Serjt.) F. Horn.
No. 10893 Pte. H. M. Howell.
No. 90257 Pte. J. G. Hunter.
No. 14464 Serjt.-Major G. F. Hurran.
No. 34131 Serjt. (Acting Staff-Serjt.) A. O. Judd.
No. 12694 Cpl. F. McCaffery.
No. 41766 Serjt.-Major J. E. Matthews.
No. 74102 Pte. (Acting Lance-Cpl.) W. J. Moody.
No. 66744 Serjt. H. J. Parker.
No. 19161 Staff-Serjt. G. Parkinson.
No. 74683 Serjt. (Acting Qmr.-Serjt.) H. W. Prince.
No. 59607 Pte. (Acting Lance-Cpl.) J. H. Robinson.
No. 30796 Staff-Serjt. L. J. Rowan.
No. 1827 Serjt T. F. Spratt.

Royal Army Medical Corps (Territorial Force).

Capt. L. Ball, M.B.
Capt. (Acting Major) W. Bowater, M.C.
Capt. (Acting Lieut.-Col.) T. A. Green, M.D., D.S.O.
Major (Acting Lieut.-Col.) G. H. L. Hammerton, D.S.O., M.C.
Capt. G. C. Soutter, M.D.
Qmr. and Hon. Capt. S. C. Wright.
Capt. B. M. Young.
No. 527010 Staff-Serjt. (Acting Serjt.-Major) S. P. Bristow.
No. 437192 Serjt. E. J. Bryden.
No. 435003 Staff-Serjt. A. Owen.

Central Chancery of the Orders of Knighthood.

St. James's Palace, S.W.,
June 3, 1918.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to give orders for the following appointment, to the Most Honourable Order of the Bath, for valuable services rendered in connexion with Military Operations in Salonika. Dated June 3, 1918 :—

To be Additional Member of the Military Division of the Third Class, or Companions, of the said Most Honourable Order :—

Col. Gerald Thomas Rawnsley, C.M.G., Army Medical Service.

War Office,
June 3, 1918.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the undermentioned rewards for distinguished service in connexion with Military Operations in Salonika. Dated June 3, 1918 :—

To be Brevet Colonel.

Lieut.-Col. F. J. Brakenridge, C.M.G., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) W. H. S. Nickerson, V.C., C.M.G., M.B., Royal Army Medical Corps.

To be Brevet Lieutenant-Colonel.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)

Major (Temp. Lieut.-Col.) C. W. Holden, D.S.O., Royal Army Medical Corps.

To be Brevet Major.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)

Capt. W. J. F. Mayne, M.B., Royal Army Medical Corps.

To be granted the Next Higher Rate of Pay under the Provisions of the Royal Warrant.

Qmr. and Hon. Capt. P. A. Baynes, Royal Army Medical Corps.

Awarded the Distinguished Service Order.

Royal Army Medical Corps.

Major (Acting Lieut.-Col.) Frederick Joseph Garland, M.B.
Capt. and Brevet-Major (Acting Lieut.-Col.) Benjamin Johnson, M.B.
Lieut.-Col. Montagu Marmion Lowsley.
Capt. (Temp. Lieut.-Col.) Hector Graham Gordon Mackenzie, M.B.
Lieut.-Col. John Robert Whait, M.B.
Major Ralph Koper White.
Temp. Major Harold Waterlow Wiltshire, M.D.

Awarded the Military Cross.

Royal Army Medical Corps.

Capt. William Dinsdale Anderton, M.B., Special Reserve.
Lieut. (Temp. Capt.) Desmond William Beamish.
Captain Eugene Henry Coyne, M.B.
Temp. Capt. Henry Harvard Davis.
Temp. Capt. Leslie Wilson Evans, M.B.
Temp. Capt. Claude Charles Harrison, M.B.
Capt. Wm. Ashley Lethem, M.B., Spec. Res.
Temp. Capt. John William Riddoch, M.B.
Capt. Frank Hubert Robbins.
Capt. Frank Scroggie, M.B.
Capt. Robert Glen Shaw, M.B.
Capt. Valentine Hutchinson Wardle.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the undermentioned rewards for distinguished services in connexion with Military Operations with the British Forces in Salonika :—

Awarded the Distinguished Conduct Medal.

No. 18627 Staff-Sergt. H. Cockburn, Royal Army Medical Corps (Southampton).

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Men, in recognition of valuable services rendered with the Forces in Salonika :—

Royal Army Medical Corps.

No. 493137 Pte. G. E. Box (Chatham).
No. 32707 Pte. (Acting Staff-Serjt.) A. E. Brown (Anfield).
No. 497003 Temp. Serjt.-Major H. G. Freeman (Kingston).
No. 30179 Serjt.-Major L. Hayes (Kew).
No. 54590 Serjt.-Major C. W. Holt, D.C.M. (Dundalk).
No. 42722 Serjt.-Major S. Jacob (Moseley).
No. 25893 Pte. (Acting Serjt.) E. G. L'Estrange (Hastings).
No. 26639 Qmr.-Serjt. (Temp. Serjt.-Major) T. Liddell (Shirebrook).
No. 39376 Serjt.-Major A. J. Magee (Craghead).
No. 497075 Serjt. W. J. Maskrey (Kingston-on-Thames).
No. 512130 Pte. (Acting Qmr.-Serjt.) H. P. B. Owen (Mitcham).
No. 510257 Pte. (Acting Cpl.) F. R. Penichelli (Hammersmith).
No. 11627 Serjt.-Major H. Secker (Glasgow).
No. 510036 Qmr.-Serjt. J. G. Sinclair (Finsbury Park).
No. 527159 Lance-Cpl. (Acting Serjt.) W. G. Stanbrook (Southend, near Reading).
No. 388258 Cpl. W. Stephenson (Willington).
No. 53159 Serjt. (Acting Qmr.-Serjt.) H. S. Todd (Blaydon).
No. 53216 Serjt. H. C. White (Hastings).

June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to signify His Majesty's intention of conferring the honour of Knighthood on the following:—

Mayo Robson, Esq., C.V.O., F.R.C.S.

For services rendered as Honorary Consulting Surgeon at the King Edward VII Memorial Hospital, Windsor. Past Vice-President of the Royal College of Surgeons.

June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give orders for the following promotions in, and appointments to, the Most Honourable Order of the Bath:—

To be Ordinary Member of the Military Division of the Third Class or Companion:—

Lieut.-Col. John Blackburn Smith, M.B., Indian Medical Service.

CHANCERY OF THE ROYAL VICTORIAN ORDER.

St. James's Palace,
June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to make the following promotions in, and appointments to, the Royal Victorian Order:—

To be Knight Grand Cross:—

Lieut.-Gen. Sir Alfred Keogh, G.C.B., C.H.

To be Knight Commander:—

Lieut.-Col. Sir Edward Scott Worthington, C.M.G., M.V.O., Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W.,
June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give orders for the following appointments to the Most Honourable Order of the Bath for services in connexion with the War, dated June 3, 1918:—

To be Additional Members of the Military Division of the Third Class, or Companions of the said Most Honourable Order:—

Col. (Temp. Major-Gen.) George Bradshaw Stanistreet, C.M.G., M.B., Army Medical Service.

Canadian Force.

Col. Alexander Primrose, Canadian Army Medical Corps.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give directions for the following promotions in, and appointments to, the Most Distinguished Order of Saint Michael and Saint George for services rendered in connexion with the War, dated June 3, 1918.

To be Additional Members of the Second Class, or Knight Commanders of the said Most Distinguished Order:—

Temp. Major-Gen. Sir Berkley George Moynihan, C.B.

Col. William Heaton Horrocks, C.B., M.B. (retired pay), Army Medical Service.

Temp. Col. Sir Ronald Ross, K.C.B., F.R.S., F.R.C.S., Army Medical Service (retired pay), Indian Medical Service.

To be Additional Members of the Third Class, or Companions, of the said Most Distinguished Order:—

Temp. Col. Arthur Stanley Woodwark, M.D., Army Medical Service.

Lieut.-Col. Francis Stephen Irvine, D.S.O., M.B., Royal Army Medical Corps.

Capt. (Temp. Hon. Lieut.-Col.) Donald John Armour, Royal Army Medical Corps (Special Reserve).

Canadian Force.

Col. George Eli Armstrong, Canadian Army Medical Corps.

Hon. Lieut.-Col. George Washington Badgerow, Canadian Army Medical Corps.

New Zealand Force.

Lieut.-Col. Cyril Hocken Tewsley, New Zealand Medical Corps.

Newfoundland Contingent.

Major Cluny Macpherson, M.D., Royal Newfoundland Regiment.

War Office,
June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the undermentioned rewards for valuable services rendered in connexion with the War, dated June 3, 1918.

TO BE BREVET COLONEL.

(On Retired List, Reserve of Officers, New Army, or Territorial Force, in the case of Officers belonging to these categories as applicable.)

Surg. Lieut.-Col. J. F. Bateson, M.B. (retired pay), late Coldstream Guards.
Surg. Lieut.-Col. E. N. Sheldrake (retired pay), late Grenadier Guards.
Lieut.-Col. A. L. A. Webb, C.M.G., Royal Army Medical Corps.
Lieut.-Col. Sir E. S. Worthington, C.M.G., M.V.O., Royal Army Medical Corps.

To be Brevet Lieutenant-Colonel.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)
Major F. G. Faichnie (retired pay), Reserve of Officers, Royal Army Medical Corps.
Capt. and Brevet Major H. M. Rigby, K.C.V.O., M.B., F.R.C.S., Royal Army Medical Corps.
Capt. and Brevet Major Sir H. J. Stiles, M.B., F.R.C.S., Royal Army Medical Corps (Temp. Lieut.-Col.), Royal Army Medical Corps.

To be Brevet Major.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories as applicable.)
Capt. H. H. Blake, M.B., Royal Army Medical Corps.
Temp. Capt. A. E. Boycott, M.D., F.R.S., Royal Army Medical Corps.
Capt. (Acting Major) A. G. R. Foulerton, F.R.C.S., Royal Army Medical Corps.
Capt. C. C. Frye, Royal Army Medical Corps.
Capt. J. Gilmour, M.C., M.B., F.R.C.S.Edin., Royal Army Medical Corps.

To be Honorary Lieutenant-Colonel.

Qmr. and Hon. Major N. G. Copping (retired pay), Royal Army Medical Corps.
Qmr. and Hon. Major A. Wilson, Royal Army Medical Corps.

To be granted the Next Higher Rate of Pay under the Provisions of the Royal Warrant.

Qmr. and Hon. Lieut. W. E. Squire, Royal Army Medical Corps.

June 3, 1918.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the award of the Meritorious Service Medal to the undermentioned Non-commissioned Officer in recognition of valuable services rendered with the British Forces on the Mediterranean Line of Communications:—

No. 1905 Staff-Serjt. (Acting Serjt.-Major) J. O. Eves, Royal Army Medical Corps (Whitehall).

Central Chancery of the Orders of Knighthood.

St. James's Palace, S.W.
June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give orders for the following promotions in, and appointments to, the Most Excellent Order of the British Empire, for services in connexion with the War.

To be Commander of the said Most Excellent Order:—

Col. William Henry Parkes, C.M.G., Director of Medical Services, New Zealand Expeditionary Force.

To be Officers of the said Most Excellent Order:—

Lieut.-Col. Alexander Bruce, Army Medical Department, War Office.
Major Edward John Buckley, for service with the British Expeditionary Force in France.
Major Charles Ernest Goddard, M.D., President of a Recruiting Medical Board.
Lieut.-Col. William Ernest Grigor, Australian Army Medical Corps.
Major George Home, Officer in charge of Surgical Division, No. 2 New Zealand General Hospital.
Major Arthur Hammersley Johnson, M.R.C.S., L.R.C.P.
Major Alexander Lewis Urquhart, Royal Army Medical Corps, for services with the British Expeditionary Force, Salonika.
Capt. Thomas George Wakeling, President of a Recruiting Medical Board.
Major John Wilson, Officer Clerk, War Office Establishment.
Capt. Alfred Harwood, Statistical Branch, Department of Director-General, Army Medical Service.

St. James's Palace, S.W.
June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give orders for the following promotions in, and appointments to, the Most Honourable Order of the Bath, for valuable services rendered in connexion with Military Operations in France and Flanders, dated June 3, 1918.

To be Additional Members of the Military Division of the Third Class, or Companions of the said Most Honourable Order:—

Temp. Major-Gen. Sir Anthony Alfred Bowlby, K.C.M.G., K.C.V.O., F.R.C.S., Army Medical Service.

Temp. Major-Gen. Cuthbert Sidney Wallace, C.M.G., Army Medical Service.
Lieut.-Col. and Brevet-Col. (Temp. Col.) Thomas Wykes Gibbard, M.B., K.H.S., Army Medical Service.
Col. Stuart Macdonald, C.M.G., M.B., Army Medical Service.
Lieut.-Col. and Brevet-Col. Allan James Macnab, F.R.C.S., Indian Medical Service.
Col. Edgar Montague Pilcher, D.S.O., M.B., F.R.C.S., Army Medical Service.
Col. George St. Clair Thom, C.M.G., M.B., Army Medical Service.

CANADIAN FORCE.

Col. Arthur Edward Rose, C.M.G., Canadian Army Medical Corps.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give directions for the following promotions and appointments to the Most Distinguished Order of Saint Michael and Saint George, for services rendered in connexion with military operations in France and Flanders, dated June 3, 1918.

To be Additional Members of the Second Class, or Knights Commanders, of the said Most Distinguished Order:—

Surg.-Gen. Menus William O'Keefe, C.B., M.D.
Col. Sir William Boog Leishman, Kt., C.B., F.R.S., M.B., F.R.C.P., K.H.P.

To be Additional Members of the Third Class, or Companions, of the said Most Distinguished Order:—

Temp. Col. Owen William Richards, D.S.O., M.D., F.R.C.S., L.R.C.P., Royal Army Medical Corps.
Col. Wilfred Edward Hudleston, D.S.O., Army Medical Service.
Col. Robert William Clements, D.S.O., M.B.
Lieut.-Col. (Temp. Col.) Edward Maudsley Morphew, D.S.O., Royal Army Medical Corps.
Lieut.-Col. Thomas Arthur Granger, M.B., Indian Medical Service.
Lieut.-Col. (Temp. Col.) Harold Collinson, D.S.O., M.B., F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) Albert George Thompson, D.S.O., M.B., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) James Stuart Gallie, D.S.O., Army Medical Service.
Lieut.-Col. William Richard Blackwell, Royal Army Medical Corps.
Major and Brevet Lieut.-Col. Eugene Ryan, D.S.O., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) James Andrew Hartigan, D.S.O., M.B., Royal Army Medical Corps.
Lieut.-Col. Albert Ernest Hamerton, D.S.O., Royal Army Medical Corps.
Major and Temp. Col. Henry McIlree Williamson Gray, C.B., M.B., F.R.C.S., Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) William Lawrence Steele, Royal Army Medical Corps.
Temp. and Hon. Major Charles George Jarvis, L.R.C.P., Royal Army Medical Corps.
Major Maurice Sinclair, M.B., Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) Edmund Thurlow Potts, D.S.O., M.D., Royal Army Medical Corps.

Canadian Force.

Col. John Munro Elder, Canadian Army Medical Corps.

Australian Force.

Col. Robert Beveridge Huxtable, D.S.O., V.D., Army Medical Corps.

War Office,
June 3, 1918.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the undermentioned rewards for distinguished service in connexion with military operations in France and Flanders, dated June 3, 1918:—

TO BE BREVET-COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)
Lieut.-Col. (Temp. Col.) G. J. A. Ormsby, D.S.O., M.D., Royal Army Medical Corps.

TO BE BREVET LIEUTENANT-COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)
Major (Temp. Lieut.-Col.) E. B. Bird, D.S.O., Royal Army Medical Corps.
Major (Acting Lieut.-Col.) C. G. Browne, D.S.O., Royal Army Medical Corps.
Major (Acting Lieut.-Col.) P. Davidson, C.M.G., D.S.O., M.B., Royal Army Medical Corps.
Major (Acting Lieut.-Col.) C. H. Turner, D.S.O., Royal Army Medical Corps.

TO BE BREVET-MAJOR.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)
Capt. L. G. Bourdillon, D.S.O., M.C., Royal Army Medical Corps.

To be Honorary Major.

Qmr. and Hon. Capt. J. W. Osborne, Royal Army Medical Corps.

To be granted the Next Higher Rate of Pay under the Provisions of the Royal Warrant.

Temp. Qmr. and Hon. Capt. C. A. Kay, Royal Army Medical Corps.

Awarded a Bar to the Distinguished Service Order.

Capt. (Temp. Lieut.-Col.) Arthur Thomas Pitts, D.S.O., Royal Army Medical Corps.

Awarded the Distinguished Service Order.

Royal Army Medical Corps.

Major Thomas Ashley Barron.
Capt. (Acting Lieut.-Col.) William Blackwood, M.B.
Capt. (Acting Lieut.-Col.) Colin Clarke, M.B., F.R.C.S.
Temp. Capt. James Alphonsus Conway, M.C., M.D.
Capt. Ernest Marshall Cowell, M.B., F.R.C.S.
Capt. (Temp. Lieut.-Col.) Francis William Murray Cunningham, M.D.
Temp. Capt. (Acting Lieut.-Col.) Ralph Evelyn Drake-Brockman.
Lieut.-Col. William Edward Foggie, M.D.
Capt. and Brevet-Major (Acting Lieut.-Col.) Claude Howard Stanly Franknau, M.B., F.R.C.S.
Temp. Capt. Samuel Sowray Greaves, M.C.
Major (Temp. Lieut.-Col.) Richard Collis Hallowes, M.B.
Capt. (Acting Lieut.-Col.) Robert Hemphill.
Temp. Capt. (Acting Lieut.-Col.) Albert Jones, M.C.
Major (Acting Lieut.-Col.) Rowland Philip Lewis.
Major (Temp. Col.) Creighton Hutchinson Lindsay, C.M.G.
Capt. Ambrose Lorne Lockwood, M.C.
Capt. (Acting Lieut.-Col.) Arthur Norman Roy McNeill.
Capt. (Acting Lieut.-Col.) Sinclair Miller, M.C.
Temp. Hon. Capt. Humphrey Nockolds.
Lieut.-Col. John Powell, M.B.
Major Alan Charles Turner.
Capt. (Acting Lieut.-Col.) Ernest Wentworth Wade, M.B.
Major Douglas Percival Watson, M.B.
Capt. (Acting Lieut.-Col.) Alfred John Williamson.

Major (Temp. Lieut.-Col.) Ernest Charles Hodgson, Indian Medical Service.
Major Ernest Albert Churchward Matthews, Indian Medical Service.

Canadian Force.

Army Medical Corps.

Lieut.-Col. George Joseph Boyce.
Lieut.-Col. Anson Scott Donaldson.
Major George Herbert Rae Gibson.
Lieut.-Col. Archibald Lorne Campbell Gilday, M.C.
Lieut.-Col. John Nisbet Gunn.
Lieut.-Col. Joseph Hayes.
Lieut.-Col. Daniel Paul Kappele.
Major Theodore Adolf Lomer.

Australian Force.

Army Medical Corps.

Major Francis Lawrence Bignell.
Lieut.-Col. Edward Thomas Brenan, M.C.
Major Arthur Ross Clayton.
Capt. Mervyn John Holmes.
Lieut.-Col. William Elphinstone Kay.
Major Donald Stuart Mackenzie.
Lieut.-Col. (Temp. Col.) Frederick Arthur Maguire.
Lieut.-Col. Balcombe Quick.
Lieut.-Col. (Temp. Col.) Arthur Edmund Shepherd.
Major Walter Jaques Stack.
Major Wilfred Vickers.

New Zealand Force.

Major Erick Arthur Widdowson, M.C.

South African Contingent.

Major Charles Molteno Murray, M.C.

Awarded a Bar to the Military Cross.

*Capt. Thomas Stokoe Elliot, M.C., Royal Army Medical Corps.
Capt. Arthur Edmund Ironside, M.C., Royal Army Medical Corps (M.C. gazetted June 24, 1916).
*Temp. Capt. George William Blomfield James, M.C., Royal Army Medical Corps.
*Capt. Hamilton Stephen Moore, M.C., M.B., Royal Army Medical Corps.
Capt. (Acting Major) Hugh Huntley Robinson, M.C., Royal Army Medical Corps (M.C. gazetted November 14, 1916).
*Capt. John Rowe, M.C., M.B., Royal Army Medical Corps.

* *Note.*—In the cases marked by an asterisk the announcements of awards of the Military Cross have not yet been published in the *London Gazette*. These awards will be published in due course.

AWARDED THE MILITARY CROSS.

Royal Army Medical Corps.

Temp. Capt. Wilfred Herbert Alderton.
Temp. Capt. Robert Harper Alexander, M.B.
Capt. Robert Pringle Anderson, M.B.
Temp. Qmr. and Hon. Lieut. George Samuel Annett.
Temp. Capt. Geoffrey Thomas Baker.
Capt. Richard Pitt Ballard, M.B., Special Reserve.
Temp. Capt. Stanley Batchelor.
Temp. Capt. William David Bathgate.
No. 34731 Serjt.-Major Alfred Bolland.
Temp. Capt. William Brownlie, M.B.
Temp. Capt. Charles Walter Gordon Bryan.
Capt. Alexander Carruthers Bryson, M.B.
Capt. Frederick Charles Chandler, M.B.
Temp. Capt. Bloomfield George Henry Connolly, M.B.
No. 45555 Serjt.-Major Leslie Alfred Cronk.
Capt. David Dempster, M.B.
Capt. James Derham-Reid.
Temp. Capt. John Wescott Dew, M.B.
Capt. George Sampson Elliston.
Temp. Capt. Keith Douglas Falconer, M.B.
Temp. Capt. Richard Desmond Fitzgerald, M.B.
Qmr. and Hon. Capt. Charles Frederick Fraser.
Temp. Capt. Hope Murray Gillsie, M.B.
Capt. Charles Norman Grover, M.B., Special Reserve.
Temp. Capt. Ranald Montague Handfield-Jones.
Capt. Nicholas Hopkins Henry Haskins, M.B.
Capt. Sidney Martin Hattersley, M.B.
Temp. Capt. John Berry Haycraft, M.B.
Temp. Capt. Godfrey John Douglas Hindley, M.B.
Temp. Capt. Austin Harvey Huycke, M.D.
Capt. David William John, Special Reserve.
Temp. Capt. Joseph Greenfield Johnston, M.B.
Capt. Griffiths Lewis Jones, Special Reserve.
Temp. Capt. David Anderson Duncan Kennedy, M.B.
Lieut. (Acting Capt.) Gerald Patrick Kidd, Special Reserve.
Temp. Capt. Francis James Lidderdale, M.B.
No. 11370 Serjt.-Major Frederick Loveland.
Capt. Donald Christopher MacDonald, M.B., Special Reserve.
Temp. Capt. William James MacDonald, M.B.
Temp. Capt. John Beattie MacFarland.
Temp. Capt. Donald MacIntyre, M.B.
Capt. William George McKenzie.
Capt. William Farquhar McLean, M.B., Special Reserve.
Capt. Henry Proce Malcolm, M.B.
Capt. Francis Robery Henry Millan, Special Reserve.
No. 2653 Serjt.-Major Frederick Charles Morriscn.
Temp. Capt. Cusack O'Malley, M.B.
Temp. Capt. Herbert Massingberd Pentreath.
Capt. George Loraine Kerr Pringle, M.D.
Capt. Albert Ramsbottom, M.D.
Temp. Capt. Ralph Stuart Renton, M.D.
Capt. Douglas George Rice-Oxley.
No. 38683 Serjt-Major John Given Richardson.
Temp. Capt. Robert Stuart Ross.
Temp. Capt. William James Rutherford, M.D.
Qmr. and Hon. Lieut. George Sellex.
Capt. Clement Perronet Sells.
Capt. John James MacIntosh Shaw, M.B.
Capt. Edward Swan Simpson, M.B.
Capt. George Henderson Stevenson, M.B., Special Reserve.
Capt. Francis Geoffrey Thatcher, M.B.
Temp. Capt. John Hardwick Thornley, M.B.
Temp. Capt. James Arnaud Tobin, M.B.
Capt. William McNiell Walker, Special Reserve.
Temp. Capt. John Watson, M.B.
Temp. Capt. Alexander Urquhart Webster, M.B.

CANADIAN FORCE.

Capt. (Acting Major) William Theodore Ewing, Army Medical Corps.

AUSTRALIAN IMPERIAL FORCE.

Army Medical Corps.

Capt. Roy Douglas Bartram.
Capt. Ivan Bede Jose.
Capt. Norman Reginald Mathews.
Capt. Cedric Murray Samson.
Capt. John Alexander Shanasy.

NEW ZEALAND FORCE.

Capt. Philip Blaxland Benham, New Zealand Medical Corps.

AWARDED THE DISTINGUISHED CONDUCT MEDAL.

Royal Army Medical Corps.

No. 536001 Qmr. Serjt. (Temp. Serjt.-Major) H. E. Bevans (St. John's, S.E.).
No. 354259 Pte. E. C. Bowkett (Manchester).
No. 303003 Staff-Serjt. (Acting Qmr. Serjt.) J. Brown (Aberdeen).
No. 55195 Serjt. D. Charleson (Leith).
No. 354100 Serjt. H. E. Dowling (Manchester).
No. 3910188 Serjt. A. Green (Hull).
No. 352080 Serjt. R. Lomax (Nelson).
No. 17091 Qmr. Serjt. (Acting Serjt.-Major) J. Moore (Edinburgh).
No. 1417 Pte. (Acting Lance-Cpl.), C. Smith (Winchester).

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
June 3, 1918.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give directions for the following appointment to the Most Distinguished Order of Saint Michael and Saint George, for services rendered in connexion with Military Operations in Italy. Dated June 3, 1918:—

To be Additional Member of the Third Class or Companion of the said Most Distinguished Order :—

Major (Acting Lieut.-Col.) George Herbert Leonard Hammerton, D.S.O., Royal Army Medical Corps.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Lieut.-Col. William Chapman Croly, Royal Army Medical Corps.

Capt. (Temp. Major, Acting Lieut.-Col.) Thomas Arthur Green, M.D., Royal Army Medical Corps.

Temp. Capt. Wilfred John Pearson, M.C., M.B., Royal Army Medical Corps.

AWARDED THE MILITARY CROSS.

Royal Army Medical Corps.

Temp. Capt. Francis John Allen, M.B.
Temp. Capt. Lawrence Weir Bain, M.B.
Temp. Capt. William Edward Hallinan.
No. 17229 Serjt.-Major William Hutchens.
Temp. Capt. Eric Alfred Lumley, M.B.
Temp. Capt. Michael Patrick Power.
Capt. Ludwig Siebert Benjamin Tasker, M.B.
No. 12146 Serjt.-Major William John Wilson.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Men in recognition of valuable services rendered with the Forces in Italy :—

ROYAL ARMY MEDICAL CORPS.

No. 18678 Qmr.-Serjt. (Temp. Serjt.-Major) L. S. Ellis (Brighton).
No. 35048 Serjt. (Acting Qmr.-Serjt.) H. H. Hards (London, N.W.).
No. 58965 Pte. (Acting Qmr.-Serjt.) D. A. Hart (London, E.).
No. 40178 Staff-Serjt. (Acting Serjt.-Major) W. Henser (Stoke).
No. 30629 Staff-Serjt. (Acting Serjt.-Major) G. Martin (Broadstairs).
No. 2007 Cpl. A. F. Morrell (Fulham).
No. 66577 Serjt. S. A. Peyton (Reading).
No. 36427 Pte. (Acting Serjt.) W. H. Pointon (Featherstone).
No. 33255 Serjt. W. A. Robertson (Glasgow).
No. 435017 Qmr.-Serjt. A. H. Stemp (Little Bromwich).
No. 90906 Staff-Serjt. (Acting Qmr.-Serjt.) F. W. G. Waghorne (Wembly).

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W.
June 3, 1918.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to give Orders for the following appointments to the Most Honourable Order of the Bath, for valuable services rendered in connexion with Military Operations in Egypt, dated June 3, 1918.

To be Additional Members of the Military Division of the Third Class or Companions of the said Most Honourable Order :—

Col. Alfred Conquer Keeble, C.M.G., D.S.O.
Temp. Lieut.-Col. James William Barrett, C.M.G., Royal Army Medical Corps.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
June 3, 1918.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to give directions for the following appointment to the Most Distinguished Order of Saint Michael and Saint George, for services rendered in connexion with Military Operations in Egypt, dated June 3, 1918 :—

To be Additional Member of the Third Class or Companion of the said Most Distinguished Order :—

Col. Daniel O'Sullivan, F.R.C.S.I., Army Medical Service.

War Office,
June 3, 1918.

His Majesty the King has been graciously pleased on the occasion of His Majesty's Birthday, to approve of the undermentioned rewards for distinguished service in connexion with Military Operations in Egypt.

TO BE BREVET LIEUTENANT-COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable).

Major H. V. Bagshawe, D.S.O., Royal Army Medical Corps.
Major C. A. Gill, Indian Medical Service.

TO BE GRANTED NEXT HIGHER RATE OF PAY.

Qmr. and Hon. Lieut. C. F. Houston, M.C., Royal Army Medical Corps.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Capt. (Acting Lieut.-Col.) Herbert William Carson, M.B., Royal Army Medical Corps.
Capt. (Acting Lieut.-Col.) John Wilson Leitch, M.B., Royal Army Medical Corps.
Capt. (Acting Lieut.-Col.) Thomas Bramley Layton, M.D., Royal Army Medical Corps.
Capt. Oakar Teichmann, M.C., Royal Army Medical Corps.
Lieut.-Col. Hugh Wright Thomson, M.D., Royal Army Medical Corps.

AUSTRALIAN FORCE.

Lieut.-Col. Arthur Lacy Dawson, Army Medical Corps.

NEW ZEALAND FORCE.

Major Charles Hercus, Medical Corps.

AWARDED THE MILITARY CROSS.

Capt. Douglas Wales Berry, M.D., Royal Army Medical Corps.
Capt. Humphrey Francis Humphreys, M.B., Royal Army Medical Corps.
Capt. Cyril Eaton Petley, Royal Army Medical Corps.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the undermentioned rewards for distinguished service in connexion with the British Forces in Egypt :—

AWARDED THE DISTINGUISHED CONDUCT MEDAL.

No. 546124 Cpl. (Acting Coy. Serjt.-Major) L. T. Leybourne, Royal Army Medical Corps (Cambridge).
No. 32251 Serjt.-Major G. F. Lyon, Royal Army Medical Corps (Norwich).
No. 12496 Staff-Serjt. (Acting Serjt.-Major) J. McKay, Royal Army Medical Corps (Aberdeen).

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Man in recognition of valuable services rendered with the Force in Egypt :—

No. 545778 Pte. (Acting Serjt.) H. J. Garrett, Royal Army Medical Corps (Bristol).
No. 56188 Serjt. D. Gibson, Royal Army Medical Corps (Stamford Hill).
No. 60270 Serjt. (Acting Staff-Serjt.) A. E. Waight, Royal Army Medical Corps (Croydon).
No. 17057 Qmr.-Serjt. (Acting Serjt.-Major) M. Ward, Royal Army Medical Corps (Belfast).

War Office,
June 11, 1918.

The following Dispatch has been received by the Secretary of State for War from Lieut.-Gen. G. F. Milne, K.C.B., D.S.O., Commander-in-Chief, British Salonika Force :—

General Headquarters, Salonika,
March 25, 1918.

MY LORD,—I have the honour to submit herewith a list of the names of the Officers, Warrant Officers, Non-commissioned Officers, Men and Nursing Staff, whose services I desire to bring to your Lordship's notice for gallant conduct and distinguished services rendered during the period from September 21, 1917, to February 28, 1918.

I have the honour to be, My Lord,
Your Lordship's most obedient servant,
G. F. MILNE, *Lieut.-Gen.*

STAFF.

Lieut.-Col. P. H. Henderson, D.S.O., M.B., Royal Army Medical Cerps.
Col. (Temp. Major-Gen.) M. P. C. Holt, K.C.M.G., C.B., D.S.O.
Col. G. T. Rawnsley, C.M.G.

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. D. I. Anderson, M.B.
Temp. Capt. G. V. Bakewell, M.B.
Temp. Capt. D. M. Borland, M.B.
Temp. Capt. R. C. Brown, M.B.
Temp. Capt. P. C. Davie, M.B.
Capt. E. Davies, M.B.
Temp. Lieut. E. Gardner, M.B.
Major (Acting Lieut.-Col.) F. J. Garland, M.B.
Temp. Capt. T. E. George, M.B.
Capt. and Brevet-Major (Acting Lieut.-Col.) B. Johnson, M.B.
Lieut.-Col. M. M. Lowsley.
Temp. Capt. L. G. McCune, M.B.
Capt. A. M. McCutcheon, M.B.
Temp. Capt. J. H. McNicol, M.C., M.B.
Temp. Capt. F. H. Morrell, Special List.
Capt. (Acting Major) A. L. Urquhart, M.B.
Temp. Lieut.-Col. C. M. Wenyon, C.M.G., M.B.
Temp. Capt. E. C. White, M.B.
Major R. K. White.
Temp. Capt. A. Wilkin.
Temp. Major H. W. Wiltshire.
No. 55375 Cpl. E. Aitken.
No. 17169 Cpl. (Acting Lance-Serjt.) W. Andrews.
No. 148 Serjt. (Acting Staff-Serjt.) J. Ashcroft.
No. 105942 Pte (Acting Serjt.) A. Ashton.
No. 56211 Cpl. (Acting Serjt.) F. Baldwin.

No. 24217 Pte. F. Barlow.
No. 80541 Staff-Serjt. G. T. Berry.
No. 53341 Pte. J. R. Brierly.
No. 69333 Pte. (Acting Cpl.) G. C. Channon.
No. 18627 Staff-Serjt. B. Cockburn.
No. 40957 Staff-Serjt. (Acting Qmr.-Serjt.) F. J. Copeland.
No. 58578 Staff-Serjt. (Acting Qmr.-Serjt.) A. Darby.
No. 1216 Pte. (Acting Cpl.) J. Dunne.
No. 50357 Cpl. (Acting Lance-Serjt.) L. Dunstall.
No. 24154 Pte. H. R. Edwards.
No. 66975 Pte. (Acting Serjt.) A. Engleby.
No. 59675 Serjt. T. Fletcher.
No. 79349 Cpl. (Acting Serjt.) H. H. Frankham.
No. 54527 Pte (Acting Lance-Cpl.) T. Froud.
No. 51445 Pte. H. J. Haynes.
No. 21340 Pte. (Acting Lance-Serjt.) R. Henderson.
No. 7246 Pte. (Acting Cpl.) T. Hickey.
No. 25810 Staff-Serjt. B. Hill.
No. 61840 Pte. G. W. Howell.
No. 75167 Pte. J. Inman.
No. 110318 Pte. (Acting Cpl.) O. E. Lloyd-Jones.
No. 23530 Qmr.-Serjt. A. Keen.
No. 78644 Serjt. (Acting Serjt.-Major) E. W. King.
No. 56640 Pte. (Acting Lance-Cpl.) J. A. Kinley.
No. 57433 Pte. K. E. Lightfoot.
No. 6367 Pte. (Acting Lance-Cpl.) J. E. Luff.
No. 36306 Cpl. (Acting Lance-Serjt.) J. P. Mannion.
No. 11211 Qmr.-Serjt. (Temp. Serjt Major) L. T. Marsden.
No. 6251 Serjt. (Acting Serjt.-Major) P. J. Martin.
No. 60081 Serjt. (Acting Staff-Serjt.) A. R. Miles.
No. 92433 Pte. R. Morris.
No. 75027 Serjt. A. Newton.
No. 76983 Serjt. J. O'Brien.
No. 39261 Cpl. (Acting Serjt.) H. Palk.
No. 31047 Pte. (Acting Lance-Cpl.) H. Parsons.
No. 68310 Pte. (Acting Cpl.) R. Paterson.
No. 60049 Pte. (Acting Serjt.) J. D. Perritt.
No. 52025 Pte. (Acting Cpl.) A. Redhead.
No. 30337 Pte. M. Ritchie.
No. 47032 Pte. F. H. Roberts.
No. 40719 Serjt. M. V. Sargent.
No. 1578 Acting Serjt. E. Savage.
No. 61753 Pte. (Acting Cpl.) W. Saxe.
No. 18957 Staff-Serjt. (Acting Company-Qmr.-Serjt.) A. C. Smith.
No. 21033 Pte. L. Spivey.
No. 79455 Pte. (Acting Cpl.) W. Stewart.
No. 68971 Pte. (Acting Lance-Serjt.) J. W. Straw.
No. 81787 Pte. R. C. Williams.
No. 19453 Staff-Serjt. A. C. Wingate.
No. 65533 Pte. R. A. Wood.
No. 1616 Cpl. (Acting Serjt.) H. C. Yates.

ROYAL ARMY MEDICAL CORPS (SPECIAL RESERVE).

Capt. T. Y. Barkley, M.B.
Capt. M. C. Cooper.
Capt. G. G. Drummond.
Capt. J. A. Musgrave,
Capt. H. B. Sherlock, M.C.
Capt. H. M. Torrance, M.B.

ROYAL ARMY MEDICAL CORPS (TERRITORIAL FORCE).

Capt. (Temp. Major) A. W. Falconer, D.S.O., M.B.
Capt. C. E. C. Ferrey.
Qmr. and Hon. Capt. G. W. Harris.
Capt. D. A. Harwood.
Capt. (Temp. Lieut.-Col.) H. G. G. Mackenzie.
Capt. W. H. Manson.
Capt. B. E. Potter.
Capt. P. S. Price.
Major and Brevet Lieut.-Col. F. E. A. Webb.
Lieut.-Col. J. R. Whait, M.B.
Capt. G. White.
Capt. H. W. Weir.
No. 493180 Serjt. A. G. Brace.
No. 527604 Staff-Serjt. T. F. Button.
No. 366128 Cpl. (Acting Lance-Serjt.) W. G. Charles.
No. 536145 Serjt. J. D. Clark.
No. 388130 Pte. T. W. Craigill.
No. 403018 Serjt. H. Duncan.
No. 497208 Serjt. A. Ford.
No. 493277 Pte. (Acting Lance-Cpl.) H. C. G. Geary.
No. 527057 Staff-Serjt. C. A. Grabham.
No. 527312 Lance-Cpl. C. S. Hasemer.
No. 495035 Pte. D. H. Hughes.
No. 510109 Pte. (Acting Lance-Cpl.) E. M Jones.
No. 495594 Pte. V. W. Joy.
No. 587167 Cpl. (Acting Serjt.) F. H. Leather-dale.
No. 497186 Cpl. G. J. Lilly.
No. 510051 Pte. L. C. Maeers.
No. 386329 Pte. C. Prescott.
No. 545627 Cpl. (Acting Lance-Serjt.) J. R. Rogers.
No. 545547 Staff-Serjt. W. H. Scott.
No. 388190 Pte. W. F. Thwaites.
No. 216018 Staff-Serjt. F. Underhill.
No. 528058 Pte. (Acting Serjt.) W. R. Wilkins.

MISCELLANEOUS LIST.

J. Ramsbottom, Esq., attached Royal Army Medical Corps.

War Office,
June 14, 1918.

The following dispatch has been received by the Secretary of State for War from General Sir E. H. H. Allenby, G.C.M.G., K.C.B., General Officer Commanding-in-Chief, Egyptian Expeditionary Force :—

General Headquarters,
Egyptian Expeditionary Force.
April 3, 1918.

My Lord,—I have the honour to forward herewith a list of Officers, Ladies, Non-commissioned Officers and Men, serving, or who have served, under my command, whose distinguished and gallant services and devotion to duty I consider deserving of special mention.

I have the honour to be, my Lord,
Your Lordship's most obedient servant,
E. H. H. ALLENBY, *General*. .

STAFF.

Capt. F. W. C. Brown, M.B., Royal Army Medical Corps.
Col. G. T. K. Maurice, C.M.G., Army Medical Service.
Lieut.-Col. (Temp. Col.) E. P. Sewell, D.S.O., M.B., Royal Army Medical Corps.

ARMY MEDICAL SERVICE AND ROYAL ARMY MEDICAL CORPS.

Temp. Lieut.-Col. J. W. Barrett, C.M.G.
Capt. (Acting Lieut.-Col.) H. W. Carson, M.B.
Lieut. (Temp. Capt.) E. Catford.
Qmr. and Hon. Capt. T. E. Coggon.
Major (Acting Lieut.-Col.) W. F. Ellis.
Lieut.-Col. W. P. Gwynn.
Temp. Capt. L. Leslie.
Temp. Capt. The Hon. L. H. Lindley, M.B.
Temp. Capt. T. F. Lumb.
Temp. Capt. (Acting Lieut.-Col.) A. T. Mulhall, F.R.C.S.I.
Temp. Capt. P. W. Moore, M.B.
Col. D. O'Sullivan, F.R.C.S.I.
Capt. (Acting Lieut.-Col.) G. F. Budkin, D.S.O.
Capt. W. H. Sheffield, M.B.
Temp. Capt. E. B. Smith, M.D.
Temp. Lieut. H. G. Sparrow.
Capt. (Acting Major) W. W. Treves, M.B., F.R.C.S.
Temp. Capt. J. G. Willmore.
No. 57267 Pte. (Acting Serjt.) F. H. Andrews.
No. 473207 Cpl. G. S. Briggs.
No. 18490 Staff-Serjt. (Acting Qmr.-Serjt.) H. Cooper.
No. 69398 Pte. C. Daly.
No. 22038 Pte. (Acting Serjt.) W. Darlington.
No. 63378 Pte. (Acting Serjt.) G. Fairclough.
No. 36115 Serjt. (Acting Staff-Serjt.) G. H. Hornby.
No. 25569 Qmr.-Serjt. (Acting Serjt.-Major) C. J. Judd.
No. 6803 Pte. W. Lee.
No. 33569 Serjt. (Acting Qmr.-Serjt.) W. Meeds
No. 32945 Serjt. F. C. Mitchell.
No. 51671 Pte. (Acting Serjt.) H. J. Rowlands.
No. 26666 Staff-Serjt. T. M. Sayer.
No. 19110 Serjt. (Acting Staff-Serjt.) C. H. Smith.
No. 16047 Qmr.-Serjt. (Temp. Serjt.-Major) P. Springett.
No. 1509 Serjt. A. Warren.
No. 1825 Serjt. (Acting Qmr.-Serjt.) A. G. Williams.

ROYAL ARMY MEDICAL CORPS (T.F.).

Capt. C. H. Allen, M.B., F.R.C.S.
Capt. C. S. P. Black, M.C., M.B.
Capt. (Temp. Major) T. G. Buchanan, M.B.
Capt. C. H. Budd, M.C., M.B.
Capt. W. K. Churchouse.
Capt. H. N. McC. Coombs, M.B.
Capt. W. F. Corfield, M.D.
Capt. A. D. Downes, M.B.
Capt. (Temp. Major) H. J. Dunbar.
Lieut.-Col. T. H. Forrest, D.S.O., M.B.
Lieut.-Col. A. G. Hamilton.
Capt. W. T. Henderson, M.B.
Temp. Capt. C. W. Jenner.
Capt. (Acting Lieut.-Col.) T. B. Layton, M.D.
Major (Acting Lieut.-Col.) J. W. Leitch, M.B.
Capt. E. A. Mackenzie
Capt. G. R. Rickett, M.D.
Capt. A. P. B. Smith.
Capt. J. B. Stanley.
Capt. O. Teichmann, M.C.
Lieut.-Col. H. H. Thomson, M.D.
Capt. F. Ward, M.D.
Capt. G. H. H. Waylen.
Capt. G. A. Williamson, M.D.
Capt. K. B. Williamson.
Capt. (Temp. Lieut.-Col.) J. Young, M.B., F.R.C.S.
No. 315086 Cpl. (Acting Serjt.) D. M. Alexander.
No. 416051 Cpl. (Acting Serjt.) H. Andrews.
No. 67947 Staff-Serjt. H. E. Eden.
No. 475165 Lance-Cpl. W. Harris.
No. 545446 Lance-Cpl. (Acting Serjt.) F. Hartley.
No. 533018 Serjt. H. S. Hiles.
No. 544796 Serjt. (Acting Serjt.) C. J. Legg.
No. 318004 Qmr.-Serjt. (Acting Serjt.-Major) W. Millar.
No. 320138 Serjt. W. Murray.
No. 362078 Serjt. W. Pritchard.
No. 303016 Qmr.-Serjt. (Acting Serjt.-Major) C. C. Thom.
No. 316087 Staff-Serjt. W. Thompson.
No. 472003 Serjt. V. J. Tootell.
No. 311064 Lance-Serjt. (Acting Serjt.) A. M. D. Wright.

War Office,
June 22, 1918.

His Majesty the King has been graciously pleased to approve of the following Awards to the undermentioned Officers and Warrant Officers, in recognition of their gallantry and devotion to duty in the Field :—

Awarded the Distinguished Service Order.

Capt. (Acting Lieut.-Col.) Robert Bernard Price, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Prior to the division going into action he took over the duties of Assistant Director of Medical Services at half an hour's notice. When on one occasion all casualty clearing stations in the neighbourhood of the division were withdrawn, his improvisation on the previous night of an emergency casualty clearing station further to the rear proved of such inestimable value, that a large number of casualties were able to be dealt with and all the wounded evacuated with the utmost dispatch. Owing to the recourse, forethought and exceptional powers of organization, the smooth and successful evacuation of all the wounded was carried out during the period of twelve days' heavy and continuous fighting in which the division was engaged.

Awarded a Bar to the Military Cross.

Capt. John Henry Pearson Fraser, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During the evacuation of a town he was in charge of a train loaded with stores and equipment. While the train was standing in the station without an engine it was heavily bombed by enemy aeroplanes. With bombs falling all round he secured an engine which had just backed into the station and coupled it to the train. He then collected a few men and cleared the permanent way of masses of débris caused by the bombs, and eventually got the train safely away under continual bombing by enemy aeroplanes. By his courage, determination and resource in a most difficult situation he succeeded in saving the whole trainload of equipment. (M.C. gazetted February 4, 1918.)

Temp. Capt. Frederick Theophilus Hill, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Several hundred casualties of all branches of the service were passed through his unit during the day, and were evacuated promptly, thanks to his zeal, energy and efficient organization. When the enemy were advancing his unit was the last to leave the neighbourhood, and finally withdrew, when ordered to do so, and when every case had been evacuated, to join the division. He displayed outstanding devotion to duty. (M.C. gazetted June 23, 1915.)

Capt. (Acting Major) Herbert Stewart Milne, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty, when in charge of an advanced dressing station. In spite of continuous shelling he dressed and superintended the evacuation of the wounded during three days' operations with great success. When a shell fell among a party of men, killing three and wounding fourteen of them, he succeeded in dressing the more severely wounded and getting them all removed to a place of safety before the next burst of fire fell in the same spot. By his courage and resource he undoubtedly saved a further loss of life. (M.C. gazetted June 3, 1918.)

Temp. Capt. Matthew Arnold Swan, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When the majority of his stretcher bearers had become casualties and his advance post had received two direct hits from shells he stayed at his post, dressed the wounded and supervised their evacuation. On many other occasions he showed the greatest courage, coolness and initiative, and his conduct has at all times been exemplary. (M.C. gazetted June 3, 1916.)

Awarded the Military Cross.

Temp. Capt. Warren Fullerton Clark, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Whilst the battery was being heavily shelled two men were badly wounded. He at once proceeded out into the open, attended to these men under the most intense shell fire, carried them into a trench, and remained with them until an ambulance arrived. He showed magnificent coolness and an utter disregard of danger.

Temp. Capt. John Norman Cruickshank, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He attended to the wounded under heavy fire during an enemy attack. His skilful organization of stretcher bearers and his coolness and determination in a most difficult situation resulted in the saving of many lives.

Capt. John Francis Hill, M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty. He worked throughout the day under incessant shell fire, attending to the wounded during an enemy attack. Owing to his coolness and skill in a most difficult situation, many lives were saved.

Temp. Capt. Andrew Ferguson Horn, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He led his bearers forward to the front line during a heavy enemy attack and brought back many severely wounded men through the enemy's barrage. Throughout the operations he displayed splendid coolness and courage under heavy fire.

Qmr. and Hon. Capt. Robert Daniel Matthews, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. On hearing that two Sisters were lying injured on the adjacent railway station, he took over dressings and attended to them and other wounded while a hostile bombing raid was in progress. He brought back all the wounded to the hospital, and later worked continuously in a burning ammunition train at great risk from exploding shells, attending to the wounded and arranging for their comfort. His gallantry and coolness were deserving of the highest praise.

No. 16216 Serjt.-Major John William Robinson, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Throughout two days he worked unceasingly, organizing and directing parties of stretcher bearers, visiting the advanced aid posts and supervising the work of the advanced dressing station, which was continuously shelled. Later, his marked organizing ability was made use of in the establishment of a new divisional collecting station to meet the emergency created by the absence of any clearing station within a short distance, and, thanks to his skill, resource and untiring energy, several hundred wounded cases were very rapidly evacuated in comparative comfort. His courage, endurance and devotion to duty during a period of ten days' fighting have been an inspiration to all ranks.

The following is the correct description of an Officer upon whom a Reward has recently been conferred :—

Temp. Capt. Alfred James Ireland, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted August 25, 1917.)

War Office,
June 17, 1918.

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Men, in recognition of valuable services rendered with the Forces in France during the present war :—

ROYAL ARMY MEDICAL CORPS.

No. 42694 Pte. (Acting Cpl.) G. H. Adams (Dartmouth).
No. 545186 Pte. (Acting Serjt.) J. P. Addison (Brandon Colliery).
No. 26361 Cpl. (Acting Serjt.) G. E. Adey (Ashby-de-la-Zouch).
No. 50222 Pte. (Acting Serjt.) F. Alden (Norwich).
No. 32268 Qmr.-Serjt. T. W. Allcard (Grimsby).
No. 32048 Serjt.-Major A. N. Appleby (Leeds).
No. 48754 Staff-Serjt. (Acting Qmr.-Serjt.) E. Barmby (Preston).
No. 417296 Acting Serjt. C. F. Beck (Derby).
No. 508269 Serjt. A. E. Bennett (London, S.E.).
No. 545494 Serjt. J. Birnie (Birkenhead).
No. 60088 Pte. (Acting Serjt.) J. J. Blackie (Duns).
No. 401249 Serjt. T. Blakebrough (Leeds).
No. 473180 Qmr.-Serjt. G. Blows (Cherry-hinton).
No. 30539 Staff-Serjt. F. G. Boxall (Chudleigh).
No. 527369 Serjt. J. Briden (Walthamstow).
No. 48322 Serjt. (Acting Qmr.-Serjt.) E. J. Brown (Coleford).
No. 17151 Serjt. (Acting Qmr.-Serjt.) J. T. Brown (E. London).
No. 42914 Pte. (Acting Serjt.) W. J. Bunting (Belfast).
No. 34922 Qmr.-Serjt. A. W. Burden (London, S.W.).
No. 538086 Qmr.-Serjt. (Temp. Serjt.-Major) F. L. Burrows (W. Newington).
No. 50328 Serjt. J. H. Campbell (Waterhouse, Co. Durham).
No. 40941 Pte. S. Campbell (Belfast).
No. 45731 Serjt.-Major W. Campbell (Dunfermline).
No. 32187 Staff-Serjt. (Acting Serjt.-Major) H. V. Cattley (Whitby).
No. 527301 Serjt. H. A. G. Chandler (Haslemere).
No. 46033 Staff-Serjt. C. H. Chaston (Leigh on-Sea).
No. 49426 Qmr.-Serjt. T. W. Clark (Sunderland).
No. 58999 Serjt. (Staff-Qmr.-Serjt.) H. Clarke (Sutton Bridge, Lincs.).
No. 2221 Serjt. (Acting Staff-Serjt.) G. Coleman (Wynberg, S. Africa).
No. 26552 Pte. S. Collins (Rhondda).
No. 352187 Pte. R. Cooper (Burnley).
No. 403556 Cpl. (Acting Serjt.) A. Cox (Mytholmroyd).
No. 16092 Cpl. (Acting Serjt.) C. Crowe (Maryborough (Queen's County).
No. 50971 Staff-Serjt. J. Dale (Woodhouse, near Sheffield).
No. 437003 Staff-Serjt. (Acting Serjt.-Major) A. H. Dancer (Sutton Coldfield).
No. 405019 Pte. F. Dent (Sheffield).
No. 403082 Qmr.-Serjt. A. M. Dewhurst (Shipley).
No. 337443 Pte. T. H. Dinsdale, M.M. (Walton).
No. 1862 Serjt. (Acting Staff-Serjt.) G. A. Doyle (Omagh).
No. 1188 Pte. (Acting Cpl.) M. Doyle (Dublin).
No. 417228 Qmr. Serjt. A. R. Ellis (Luton).
No. 527244 Pte. (Acting Serjt.) W. A. Ellis (Stamford Hill).
No. 545075 Serjt. E. Ellison (Essington).
No. 17450 Staff-Serjt. (Acting Qmr. Serjt.) W. J. Elsey (Pembroke Dock).
No. 19039 Serjt. (Acting Qmr.-Serjt.) J. T. Emerson (Cosham).
No. 56602 Staff-Serjt. (Acting Qmr.-Serjt.) E. Evans (Sunderland).
No. 536333 Qmr.-Serjt. I. Fisher (Wood Green).
No. 1464 Serjt. (Acting Qmr.-Serjt.) J. Fitzgerald (Aldershot).
No. 61935 Cpl. (Acting Lance-Serjt.) R. J. Fitzgibbons (Kennington Cross, S.E.).
No. 49093 Serjt. J. Fooks (Watchet, Somerset).

No. 4945 Serjt. (Acting Staff-Serjt.) J. E. Forman ((E). Aldershot).
No. 40655 Serjt.-Major H. J. C. Frewin (Ruislip).
No. 18507 Staff-Serjt. (Acting Qmr.-Serjt.) W. A. Gerrie (Aldershot).
No. 495216 Serjt. R. J. Giles (Folkestone).
No. 14452 Serjt. (Acting Staff-Serjt.) F. Godfrey (Edinburgh).
No. 514001 Qmr.-Serjt. (Temp. Serjt.-Major) W. R. Gillett (Clapham, S.W.).
No. 341279 Cpl. (Acting Serjt.) A. D. Goulding (St. Helens).
No. 73745 Pte. (Acting Cpl.) A. W. Grattidge (Leicester).
No. 545673 Pte. (Acting Serjt.) D. Gray (Carlisle).
No. 36896 Cpl. (Acting Serjt.) G. B. Green (Eastbourne).
No. 5168 Serjt. (Acting Qmr.-Serjt.) H. Gregory (Manchester).
No. 493322 Serjt. G. Gurney (Gillingham).
No. 59489 Serjt.-Major C. G. Gwynn (Hastings).
No. 45612 Serjt. J. C. Hagger (New Barnet).
No. 37849 Pte. (Acting Serjt.) D. Hall (Oldham).
No. 20478 Staff-Serjt. J. W. Hastings, D.C.M. (Manchester).
No. 395019 Serjt. A. Hedley (Newcastle-on-Tyne).
No. 72241 Serjt.-Major F. G. Herbert (Leicester).
No. 72152 Serjt. (Acting Qmr.-Serjt.) F. H. Herbert (Bromley, Kent).
No. 17250 Serjt. (Acting Staff-Serjt.) A. Hobbs (Guildford).
No. 47316 Serjt. (Acting Staff-Serjt.) P. G. Holloway (Bath).
No. 512250 Qmr.-Serjt. E. A. Hopkins (Harringay).
No. 58454 Staff-Serjt. (Acting Serjt.-Major) F. M. Hudson (South Shields).
No. 341291 Serjt. W. A. Hunter (St. Helens).
No. 17576 Qmr.-Serjt. (Acting Serjt.-Major) J. R. Ireson (Southminster).
No. 30623 Serjt.-Major J. R. Ivins (Chelsea, S.W.).
No. 534004 Staff-Serjt. W. James (Erith, Kent).
No. 38805 Serjt. (Acting Staff-Serjt.) E. C. Jeeves (Blunham).
No. 66321 Serjt.-Major F. W. Jeffries (Ringwood).
No. 19471 Cpl. (Acting Serjt.) D. C. Johnston (Bridge of Dunn).
No. 39536 Qmr.-Serjt. W. H. Jones (Barry Dock, Glam.).
No. 30624 Qmr.-Serjt. J. Judd, (Brixton, S.W.).
No. 339004 Lance-Serjt. J. Kay (Liverpool).
No. 4924 Pte. (Acting Cpl.) A. B. Kelly (Trimm, Co. Meath).
No. 13814 Qmr.-Serjt. (Acting Serjt.-Major) P. Kenneally (Castlemartyr).
No. 13032 Qmr.-Serjt. T. Kerr (Ballymena).
No. 19268 Cpl. (Acting Staff-Serjt.) J. B. Kersey (St. Leonards-on-Sea).
No. 345009 Serjt. (Acting Serjt.-Major) N. F. Kirkwood (Liverpool).
No. 73691 Pte. (Acting Cpl.) R. W. Kirtley (South Shields).
No. 55230 Cpl. (Acting Serjt.) W. J. Lawrence (Balham, S.W.).
No. 16442 Staff-Serjt. (Acting Qmr.-Serjt.) W. Lawson (Dublin).
No. 339483 Serjt. J. S. Leigh (Blackpool).
No. 2257 Serjt. T. J. Lever (Wolverhampton).
No. 527613 Staff-Serjt. (Acting Serjt.-Major) J. S. Lindley (Batley, Yorks).
No. 457372 Pte. (Acting Lance-Cpl.) R. Luxton (Exeter).
No. 16678 Qmr.-Serjt. (Acting Serjt.-Major) J. E. March (Leicester).
No. 60984 Serjt. J. G. Mark (Castle Eden, Durham).
No. 350168 Pte. J. B. Marsden (Glossop).
No. 18632 Pte. (Acting Serjt.) F. Martin (Gravesend).
No. 49848 Pte. (Acting Lance-Cpl.) G. Martin (Dublin).
No. 457240 Staff-Serjt. (Acting Qmr.-Serjt.) S. Martin (Torpoint).
No. 5808 Cpl. (Acting Staff-Serjt.) M. M. D. Maxwell (Worcester).
No. 14850 Staff-Serjt. (Acting Qmr.-Serjt.) T. G. Mayman (Southsea).
No. 49626 Pte. C. McConkey (Liverpool).
No. 12155 Serjt.-Major A. McKay (Aberdeen).
No. 35258 Qmr.-Serjt. D. McKechnie, M.M. (Dundee).
No. 59373 Serjt. W. Mellor (Manchester).
No. 12537 Qmr.-Serjt. (Temp. Serjt.-Major) F. Molloy (Cork).
No. 41200 Staff-Serjt. G. Morrell (Leeds).
No. 459420 Pte. E. W. Mumford (Lelant).
No. 19605 Cpl. (Acting Qmr.-Serjt.) M. Nairn (Colchester).
No. 403337 Serjt. W. Naylor (Knaresborough).
No. 510211 Serjt. E. E. Nott (Catford, S.E. 6).
No. 417221 Serjt. J. L. Oakes (Derby).
No. 15721 Serjt.-Major A. E. Odell (Loughborough).
No. 56588 Pte. W. O'Hare (Clough, Co. Down).
No. 386009 Qmr.-Serjt. (Acting Staff-Serjt.) H. Ord (Gosforth, Newcastle-on-Tyne).
No. 18213 Staff-Serjt. W. C. Pacey (Bordon).
No. 463003 Qmr.-Serjt. L. Parkhouse (Exeter).
No. 18718 Qmr.-Serjt. (Temp. Serjt.-Major) W. H. Parr (Lee, Kent).
No. 341430 Qmr.-Serjt. (Temp. Serjt.-Major) R. R. Parry (Liverpool).
No. 459002 Qmr.-Serjt. (Temp. Serjt.-Major) T. W. Parsons (Chudleigh, S. Devon).
No. 2225 Cpl. M. Paterson (York).
No. 32424 Pte. (Acting Cpl.) R. V. Peake (Southsea).
No. 65795 Serjt. A. C. Piper (Hailsham).
No. 17421 Serjt. P. Plume (Bury St. Edmunds).
No. 15096 Serjt.-Major J. E. Pugh (Shrewsbury).
No. 34410 Qmr.-Serjt. A. H. Purser (Cowes).
No. 61620 Staff-Serjt. H. Race (Bradford, Yorks).
No. 310022 Staff-Serjt. F. Rae (Aberdeen).
No. 37249 Serjt. J. Rattray (Perth).
No. 461029 Pte. (Acting Serjt.) A. Reed (Southampton).
No. 85911 Pte. (Acting Serjt.) J. F. Riggs (Pimlico, S.W.).
No. 33404 Cpl. S. T. Roberts (Liverpool).
No. 35954 Serjt.-Major D. C. S. Robertson (West Hartlepool).

No. 50101 Pte. (Acting Serjt.) A. W. Robinson (St. Ives).
No. 106920 Pte. R. Rooke (Boughton, near Faversham).
No. 39472 Staff-Serjt. (Acting Qmr.-Serjt.) A. V. Rowe (Middlewick).
No. 6125 Cpl. (Acting Serjt. A. J. Sage (E. Waterford).
No. 19933 Staff-Serjt. (Acting Qmr. Serjt.) W. C. Savegar (Aldershot).
No. 341411 Qmr.-Serjt. (Temp. Serjt.-Major) F. C. Scrutton (Penketh).
No. 47208 Serjt. J. A. Sharpley (Sunbury-on-Thames).
No. 527541 Staff-Serjt. G. W. Shipley (Marske-by-Sea).
No. 12411 Staff-Serjt. (Acting Qmr.-Serjt.) A. A. Sims (Reading).
No. 44847 Pte. (Acting Cpl.) H. Slee (Leeds).
No. 78018 Serjt. (Acting Qmr.-Serjt.) H. S. Smith (Mexborough).
No. 37373 Qmr.-Serjt. G. R. Spragg (Cheltenham).
No. 303053 Qmr.-Serjt. J. Stables (Kennethmont).
No. 38707 Serjt.-Major W. B. Stedman (Margate).
No. 17568 Serjt.-Major E. Steele (Surbiton).
No. 43087 Serjt. J. F. Stephen (Inverallochy).
No. 44817 Cpl. G. H. Stewart (Paisley).
No. 39086 Staff-Serjt. T. Stinton (Manchester).
No. 301010 Qmr.-Serjt. C. F. Stuart (Torvie).
No. 11801 Cpl. (Acting Staff-Serjt.) J. Sturges (Oxford).
No. 49938 Qmr.-Serjt. N. Sumner (Warrington).
No. 4682 Serjt. A. E. Taylor ((E) Aldershot).
No. 42273 Serjt. W. Taylor (Bridlington).
No. 435317 Qmr.-Serjt. W. H. Taylor (Birmingham).
No. 545447 Pte. (Acting Lance-Serjt.) J. Topping (Carlisle).
No. 301241 Staff-Serjt. (Acting Qmr.-Serjt.) L. G. Tough (Aberdeen).
No. 35693 Serjt. (Acting Staff-Serjt.) W. J. Twidell (Luton).
No. 527140 Staff-Serjt. I. I. Ungar (Listria Park, N.).
No. 12790 Cpl. (Acting Serjt.) L. P. Unwin (Thornton Heath).
No. 34259 Staff-Serjt. W. Uden (Catford, S.E.).
No. 5880 Cpl. (Acting Qmr.-Serjt.) W. C. Vallance (Dublin).
No. 49962 Staff-Serjt. (Acting Qmr.-Serjt.) P. Walmsley (Brooke's Bar).
No. 18126 Serjt. (Acting Qmr.-Serjt.) T. P. Walshe (Rochester).
No. 18621 Staff-Serjt. (Acting Serjt.-Major) A. J. Walton (Birmingham).
No. 67281 Serjt. W. P. Waterhouse (Levenshulme).
No. 11320 Serjt.-Major R. Watts (Upper Tooting).
No. 493320 Qmr.-Serjt. (Temp. Serjt.-Major) W. W. Weedon (Maidstone).
No. 18821 Staff-Serjt. (Acting Serjt.-Major) G. Weston (Rochester).
No. 32197 Serjt.-Major J. S. Witham (Burnley).
No. 405420 Cpl. (Acting Serjt.) H. Wilde (Bradford).
No. 31747 Serjt.-Major G. M. Wilshaw (Burnley).
No. 401417 Staff-Serjt. A. E. Wood (Leeds).
No. 71796 Pte. E. F. Wood (Denholme).
No. 527854 Staff-Serjt. (Acting Serjt.-Major) F. H. Wood (Bromley).
No. 4356 Serjt. R. Woodman (Shepherd's Bush).
No. 5442 Serjt. (Acting Qmr.-Serjt.) A. E. Woodward (Stonehouse).
No. 15022 Staff-Serjt. (Acting Serjt.-Major) F. Woodward, D.C.M. (E. Swindon).
No. 64046 Serjt. D. Yates (Norton Malton).

June 26, 1918.

His Majesty the King has been pleased to award the Distinguished Conduct Medal to the undermentioned for Gallantry and Distinguished Service in the Field :—

No. 1828 Pte. M. Connolly, Royal Army Medical Corps (Dublin).

For conspicuous gallantry and devotion to duty. On an advanced aid post being subjected to a prolonged bombardment, during which period two direct hits from enemy shells were registered on it, he stayed at his post, and wherever casualties occurred he went out to bring in the wounded, rescuing six men in such a manner. Throughout this period he afforded magnificent proof of utter contempt for danger and outstanding devotion to duty.

No. 493540 Pte. R. B. McCoy, Royal Army Medical Corps (Maidstone).

For conspicuous gallantry and devotion to duty when the aerodrome of the squadron to which he was attached was attacked by enemy aircraft. He was badly wounded in the thigh by the first bomb that fell, and though he could only walk with great difficulty, he struggled towards the other casualties and attended to them while bombs were still dropping and the enemy aeroplanes were attacking the aerodrome with machine-gun fire. His splendid courage and self-sacrifice saved the life of a man who would have died had he not been attended to immediately.

June 27, 1918.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned :—

No. 223 Serjt. (Acting Staff-Serjt.) W. Peake, M.M., Royal Army Medical Corps (Layerthorpe). (M.M. gazetted April 10, 1918.)

His Majesty the King has been graciously pleased to approve of the award of the Military Medal to the undermentioned Non-commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

No. 106789 Pte. W. Ashton (Blackburn).
No. 426012 Serjt. G. W. Boaler (Leicester).
No. 19311 Pte. (Acting Cpl.) H. J. Cantello (Lavender Hill).
No. 32017 Pte. M. H. Cheetham (Sydenham).
No. 40527 Pte. (Acting Lance-Cpl.) J. Clarke (Middlewich).
No. 70568 Pte. W. Cox (Sheffield).
No. 315092 Pte. (Acting Lance-Cpl.) A. E. Dickson (Glasgow).
No. 493605 Pte. J. B. F. Duffett (Maidstone).
No. 495390 Pte. S. T. Edinborough (Folkestone).
No. 7227 Pte. (Acting Cpl.) J. Finn (Sheffield).
No. 61631 Pte. J. W. Gallagher (Dublin).
No. 44420 Pte. G. Glover (Hindley).
No. 6305 Cpl. (Acting Serjt.) A. W. Goswell (Folkestone).
No. 31557 Pte. W. H. Gotts (E. Bury St. Edmunds).
No. 31561 Pte. A. Green (Forest Hill).
No. 7491 Pte. C. T. Hartley (Bletchley).
No. 43543 Pte. P. L. Jarrett (Maidstone).
No. 493397 Pte. (Acting Cpl.) A. Larkin (Speldhurst).
No. 352589 Pte. W. Lawson (Manchester).
No. 73581 Pte. W. Leslie (Glasgow).
No. 31386 Pte. J. McPherson (Edinburgh).
No. 495335 Pte. H. A. W. Rainer (Folkestone).
No. 8881 Pte. J. Scholefield (Shipley).
No. 32668 Cpl. L. E. Smith (Sheffield).
No. 9024 Pte. E. Walton (Leeholme).
No. 59458 Pte. F. White (Tooting).
No. 12185 Staff-Serjt. (Acting Qmr.-Serjt.) A. S. Willis (Harringay).

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS of a Committee meeting held at the Royal Army Medical College, Grosvenor Road, on Monday, June 10, 1918, at 2 p.m., the Director-General, Army Medical Service (Lieut-Gen. T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., K.H.S.), presiding.

Present.

Major-Gen. G. B. Stanistreet, C.B., C.M.G., D.D.G., A.M.S.
Major-Gen. Sir W. Donovan, K.C.B.
Surg.-Gen. Sir D. Bruce, K.C.B.
Col. Sir J. Magill, K.C.B.
Lieut-Col. A. B. Cottell.
Major E. P. Offord.

(1) The minutes of the last meeting were read and confirmed.

(2) The question as to whether the education of children shall be undertaken by the General Relief Branch when the Compassionate School Fund is exhausted was considered, and it was decided to recommend to the Annual General Meeting that the principle should be approved, subject of course to the financial condition of the Fund at any time.

(3) The draft of proposed book of rules as recommended by the sub-committee was considered and adopted with certain minor amendments, and it was decided to recommend to the Annual General Meeting that it shall be adopted and printed at a cost not exceeding £10.

(4) The report of the memorials sub-committee was received, and after discussion it was decided to recommend to the Annual General Meeting—

(i) That a suitable memorial with portrait medallions of officers who were mainly concerned in the movement that led to the unification of the Army Medical Department and to the formation of the R.A.M.C. be erected in the Royal Army Medical College at a cost not exceeding £500.

(ii) That a special portrait of Lieut.-Gen. Sir A. Keogh, wearing the Insignia of the Grand Cross of the Bath, should be painted, and

(iii) That a portrait of Lieut.-Gen. Sir A. Sloggett, K.C.B., K.C.M.G., K.C.V.O., K.H.S., should be added to the gallery of Director-Generals in the mess room.

(5) Two applications for assistance from the General Relief Branch were considered and grants approved. In the case of one where there is a possibility of the pension being increased the amount not to exceed £1 a month up to a maximum of £6.

THE sixteenth Annual General Meeting of the Royal Army Medical Corps Fund was held in the library of the Royal Army Medical College on Monday, June 10, 1918, the Director-General (Lieut-Gen. T. H. J. C. Goodwin C.B., C.M.G., D.S.O., K.H.S.) presiding.

(1) The report of the Committee was read and adopted as follows:—

(i) The number of annual subscribers has diminished from 984 in 1916 to 824 in 1917; a considerable number of the young officers who were granted permanent commissions last year have joined in response to a circular letter which was sent out in August, and no doubt others will subscribe at the termination of the war. The Fund has sustained heavy losses by death.

(ii) The accounts of the Fund have been separated into two branches, viz., Officers' Branch for band dinner and memorials, and General Relief Branch, which includes the small amount still remaining which was originally allocated specially for the education of children.

STATEMENT OF ACCOUNTS OF THE OFFICERS BRANCH FOR THE YEAR 1917.

RECEIPTS.	£	s.	d.
To Balance at Bank, December 31, 1916	397	17	10
,, Subscriptions	1,080	15	6
,, Dividends :—			
Caledonian Railway (Less Tax)	42	4	10
North British Railway (Less Tax)	43	14	2
,, War Loan 5 %	67	3	10
,, £600 Exchequer Bonds 5 %	11	11	0
,, Sold £23 13s. 6d. 5 % War Loan on Conversion	22	6	8
	£1,665	13	10

EXPENDITURE.		£	s.	d.
By Grants to Band		100	0	0
,, Fire Insurance for Q.A.M.H. Chapel		4	5	6
,, Royal School for Officers' Daughters		26	5	0
,, Easter Cards for Russian Medical Officers		6	15	0
,, Purchased £400 War Loan 5 %		380	0	0
,, ,, £400 ,, ...		381	6	0
,, ,, £50 ,, to make up total to £1,500		47	8	7
,, Three Subscriptions credited in error repaid ..		3	0	0
,, Office Expenses :—				
Shorthand Clerk	1 1 0			
Auditor	1 1 0			
Office Allowance	165 0 0			
Stationery, Postage and Printing ..	15 8 9			
Furniture, Telephone, &c. ..	3 10 0			
Cheque Book	0 4 2			
		186	4	11
,, Balance at Bank, December 31, 1917		530	8	10
		£1,665	13	10

INVESTMENTS (AT COST).

Caledonian Railway 4 % Preference Stock	£1,408	0	0
North British Railway 4 % Preference Stock ..	1,457	0	0
War Loan 5% £2,300	2,186	7	11
	£5,051	7	11

,, Office Expenses £186 4 11

(Two-thirds of this will be refunded in 1918 ; One-third by R.A.M.C. Fund (General Relief Branch) ; One-third by R.A.M.C. Benevolent Society.)

We have compared the above statement with the books and vouchers relating thereto, and certify it to be correct. We have verified the Bank Balance and the Investments.

Portland House,
Basinghall Street, E.C.
April 30, 1918.

(*Signed*) EVANS, PEIRSON & CO.,
Chartered Accountants.

STATEMENT OF ACCOUNTS OF THE GENERAL RELIEF BRANCH FOR THE YEAR 1917.

Receipts.	£	s.	d.
To Balance in hand, December 31, 1916	404	0	10
,, Grants from Companies and Units	1,475	8	2
,, Subscriptions and Donations	19	2	0
,, Dividends :—			
Canada Registered Stock	17	0	11
East India Railway Debenture Stock	27	16	4
War Loan	95	15	7
,, £1,000 Exchequer Bonds 6 %	52	0	4
,, £1,800 ,, ,, 5 %	46	4	0
	£2,137	8	2
,, Schools Account, as per Statement attached ..	144	0	5
	£2,281	8	7

Expenditure.	£	s.	d.
By Grants to Companies	46	15	0
,, Union Jack Club	25	4	0
,, Soldiers and Sailors Help Society	5	0	0
,, Association for Employment of ex-Soldiers ..	5	0	0
,, R.A.M.C. Comforts	25	0	0
,, A. and N. Male Nurses Co-operation	20	0	0
,, Corps of Commissionaires	10	0	0
,, Transferred to Auxiliary R.A.M.C. Fund	411	14	6
,, Purchased £400 War Loan	380	0	0
,, ,, £700 National War Bonds	700	0	0
,, Bankers' Charges	2	0	0
,, Excess Dividends credited in error on War Loan—refunded	1	8	8
	£1,632	2	10
,, Schools Account, as per Statement attached ..	46	0	0
	£1,678	2	10
,, Balance Credit	603	5	9
	£2,281	8	7

Investments (at Cost).	£	s.	d.
Canada 3½ % 1930/50 Stock	606	1	3
East India Railway Co. 3½ % Debenture Stock ..	1,060	0	0
£1,000 6 % Exchequer Bonds, 1920	1,000	0	0
£2,926 6s. War Loan 5 % Investment Stock	2,780	0	0
£700 National War Bonds	700	0	0
	£6,146	1	3

We have compared the above statement with the books and vouchers relating thereto, and certify it to be correct. We have verified the Bank Balance and the Investments.

Portland House,
Basinghall Street, E.C.
April 30, 1918.

(*Signed*) EVANS, PEIRSON & CO.
Chartered Accountants.

STATEMENT OF ACCOUNTS OF THE COMPASSIONATE SCHOOL FUND FOR THE YEAR 1917.

Receipts.		£ s. d.	Expenditure.		£ s. d.
To Balance in hand, December 31, 1916—			By Royal Soldiers' Daughters' Home		19 0 0
Current Account	£141 10 5		,, Drummond Institute		15 0 0
Deposit Account	100 0 0		,, Catholic Home for Destitute Children		12 0 0
		241 10 5			£46 0 0
,, Interest on Deposit Account		2 10 0	,, Balance in hand, December 31, 1917—		
			Current Account	£98 0 5	
			Deposit Account	100 0 0	
					198 0 5
		£244 0 5			£244 0 5

We have compared the above statement with the books and vouchers relating thereto, and certify same correct. We have verified the Bank Deposit Account.

Portland House,
Basinghall Street, E.C.
April 30, 1918.

(*Signed*) EVANS, PEIRSON & CO.,
Chartered Accountants.

(iii) *Officers Branch.*—The income amounted to £1,267 16s., and as the expenditure continues to be small owing to the War, £850 has been invested in War Loan, 1915, 5 per cent., making a total now held by the branch in that security of £2,300.

(iv) *Dinner.*—There was no dinner last year and no expenditure on memorials.

(v) *Band.*—A grant of £100 has been made to the band.

(vi) *General Relief Branch.*—Grants and subscriptions to the amount of £1,494 10s. 2d. were received from companies and units abroad and as the applications for assistance were few in number a further sum of £1,100 has been invested in War Loan 5 per cent and National War Bonds. The annual subscriptions to the Union Jack Club and other societies are met by this branch.

(vii) *Compassionate School Fund.*—Grants have been made to the Royal Soldiers' Daughters' Home at Hampstead, the Drummond Institute in Ireland and the Catholic Home for Destitute Children, at each of which we have children being educated, and the sum of £198 remains. This will be sufficient to complete the education of the children now at school.

(viii) The Committee record with deep regret the death of Lieut.-Col. F. W. H. Davie Harris who had been secretary of the Society for more than eleven years and to whose unfailing efforts in the interests of the Fund much of its success is undoubtedly due.

(2) The accounts for the year 1917 which have been audited were considered and approved. A copy is attached to the *Proceedings.*

(3) The question of voting a grant from the Officers Branch to the General Relief Fund was discussed, and it was proposed by Col. C. R. Tyrrell, and seconded by Lieut.-Gen. A. T. Sloggett, that a sum of £25 be authorized. Carried.

(4) The principle as to whether the education of children shall be undertaken by the General Relief Branch when the sum of money still remaining in the Compassionate School Fund is exhausted was discussed. It was explained by the secretary that this Fund originated in a sum of nearly £1,400 subscribed by No. 6 General Hospital during the South African War and limited at the request of Col. Somerville Large, who was then in command, to the education of children. This amount is nearly exhausted and it is a question whether when it has been expended the education of children will subsequently be taken over by the General Relief Fund. After discussion it was proposed by Gen. Sir W. Donovan and seconded by Gen. Sir M. Russell, and carried, that the principle be approved that the education of children shall be taken over by the General Relief Fund when the sum belonging to the Compassionate School Fund is exhausted, subject to the financial position of the Fund at any future time.

(5) The proposed book of rules which has been circulated was approved with certain minor alterations to be adopted and printed, the cost not to exceed £10.

(6) *Memorials.*—The recommendation of the Committee as regards memorials to distinguished officers was considered and adopted as follows:—

(i) That a suitable memorial with portrait medallions of officers who were mainly concerned in the movement that led to the unification of the Army Medical Department and to the formation of the Royal Army Medical Corps be erected in the Royal Army Medical College at a cost not exceeding £500.

(ii) That a special portrait of Lieut.-Gen. Sir A. Keogh, wearing the Insignia of the Grand Cross of the Bath, should be painted, and

(iii) That a portrait of Lieut.-Gen. Sir A. Sloggett, K.C.B., K.C.M.G., K.C.V.O., K.H.S., should be added to the Gallery of Director-Generals in the mess room.

As regards the portraits, as there is at the present time great uncertainty as to the cost, the Committee are requested to furnish a further report before the matter is finally sanctioned.

(7) *Auditors.*—It was proposed by Sir D. Bruce and seconded by Sir W. Donovan that Messrs. Evans, Peirson and Co. be reappointed for the present year.

(8) A letter was read from Mr. V. G. M. Holt recommending that the £1,000 6 per cent. Exchequer Bonds, 1920, standing in the names of the trustees on account of the General Relief Branch should be sold and the proceeds invested in 5 per cent National War Bonds, 1928, and the difference resulting from the transaction added to the present holding of the Fund. It was "Resolved that Messrs. Holt and Co. be instructed to sell £1,000 6 per cent. Exchequer Bonds, 1920, held on account of the General Relief Fund, and to take up £1,200 5 per cent. National War Bonds, 1928, to be invested in the names of the trustees. Also that the Director-General be authorized to sign the Resolution on behalf of the Fund."

(9) The secretary reported that a sum of £28 13s. 6d. had been received as a Rebate of Income Tax for the General Relief Branch for the year 1917.

Secretary.—Proposed by Sir Launcelotte Gubbins and seconded by Sir A. Sloggett that Lieut.-Col. Wilson be elected secretary for one year. Carried.

E. M. Wilson,
Lieut.-Col., Secretary.

MINUTES OF A COMMITTEE MEETING HELD AT ADASTRAL HOUSE, WAR OFFICE, ON JULY 17, 1918.

Present:

Lieut.-Gen. T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., K.H.S., Director General, in the Chair.
Major-Gen. G. B. Stanistreet, C.B., C.M.G., Deputy Director-General.
Major-Gen. Sir W. Donovan, K.C.B.
Col. C. R. Tyrrell, C.B.
Lieut.-Col. A. B. Cottell.
Major P. G. Easton, D.S.O.
Major E. P. Offord.

(1) The minutes of the previous meeting, held on June 10, were read and confirmed.

(2) The Secretary reported the printing of 600 copies of the new book of Rules which are being distributed to the subscribers.

(3) The Report of the Memorials Sub-Committee was considered and it was decided :—

(i) As regards the Memorials to certain distinguished officers who were mainly concerned in the unification of the Army Medical Department and the formation of the Royal Army Medical Corps that before making a final selection notification should be sent to :

(*a*) All Surgeon-Generals and Major-Generals, past and present, and

(*b*) All officers who were on the active list between 1870 and 1880, giving the names of officers provisionally proposed and asking for suggestions. The replies to be considered at the next meeting.

(ii) The offer of Mr. F. O. Salisbury to paint the portrait of Lieut.-Gen. Sir A. T. Sloggett was approved. The total inclusive charge not to exceed the amount agreed upon.

(iii) It was noted that the Memorials Sub-Committee are in communication with Sir A. Keogh.

(4) The Secretary submitted a Report of the meeting of the "Comrades of the Great War" Association on July 4, and it was decided that no action is necessary at present.

(5) A case of special distress under Rule 5 was considered and it was decided to sanction a monthly grant of £5 as a temporary measure pending the result of an appeal for an increase of pension which is now being dealt with by the financial authorities.

(6) The Secretary reported the sale of £1,000 6 per cent Exchequer Bonds and the purchase of £1,200 5 per cent National War Bonds which had been carried out on behalf of the General Relief Branch in accordance with the Resolution of the Annual General Meeting. He also reported the present cash balances in both branches of the Fund.

(7) An application for assistance from the widow of an ex-Staff-Serjeant under Rule 8 was considered and a grant of £6 authorized.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

THE Annual General Meeting was held at the Library, Royal Army Medical College, Grovesnor Road, S.W., at 3 p.m. on Monday, June 10, 1918, the Director-General, Army Medical Service (Lieut.-General T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., K.H.S.), presiding.

(1) The Minutes of the last Annual General Meeting were read and confirmed.

(2) The report of the Committee for the year 1917 was considered and adopted as follows :—

The number of subscribers for the year was 181 and the amount of subscriptions £184 18s. 6d.

A sum of £196 7s. 6d. has been received as a rebate of Income Tax and is credited in the accounts for the year 1918.

Donations were received from :—

Officers' Mess Training Centre, Ripon	£20	0	0
Lieut.-Col. and Mrs. Brunskill	5	0	0
Royal Army Medical Corps Officers' Mess, Rawal Pindi	16	7	9
Surg.-Gen. and Mrs. Julian	30	0	0
An Anonymous Friend, per Major T. H. Gibbon	14	0	0
A Legacy under the Will of the late Surg.-Gen. Sir Charles Cuffe ..	10	0	0

The total receipts amounted to £646 7s. 2d.

The £200 Exchequer Bonds purchased in 1916 have been converted into £200 5 per cent War Loan and an additional amount purchased bringing up the total holding of the Society in that Security to £450.

The total expenditure amounted to £735 3s. The office expenses for 1917 are being charged to the accounts of the year 1918, and will amount to £62 1s. 8d.

Thirty-one applicants representing fifty-eight orphans were granted £755.

The Committee record with deep regret the death of Lieut.-Col. Davie Harris, who had been secretary of the Society for more than eleven years, and to whose unfailing efforts in the interests of the Fund much of its success is undoubtedly due.

(3) The audited accounts for the year 1917 were received and approved. A copy is attached to these Proceedings.

(4) The grants to applicants recommended by the Committee for the year were considered and approved. Two other applications which had been received since the Committee meeting were considered and grants authorized. In a third case the application was refused. The amounts voted together with the initials of the applicants are attached.

(5) The Secretary reported that nearly 600 special notices had been sent out with a view to increasing the number of subscribers, and up to the present time forty-seven additional officers had joined the Society.

(6) The resignation of Col. J. L. Notter as Vice-President was accepted with regret, and it was proposed by Major-Gen. Sir W. Donovan and seconded by Col. Peterkin that Surg.-Gen. Sir Michael Russell be elected Vice-President. Carried. The other Vice-Presidents were re-elected.

(7) It was proposed by the Chair and seconded by Sir Launcelotte Gubbins that Surg.-Gen. Sir H. R. Whitehead be elected a member of the Committee. Carried. And that the remainder of the Committee be re-elected. Carried.

(8) *Auditors.*—The Auditors, Messrs. Evans, Peirson and Co., were re-elected Auditors.

(9) Lieut.-Col. E. M. Wilson was re-elected Secretary for one year from the present date.

(10) It was proposed by Sir A. Sloggett and seconded by Sir Launcelotte Gubbins that a very hearty vote of thanks be accorded to the Director-General for presiding at both meetings. Carried.

E. M. Wilson, *Lieut.-Colonel,*
Secretary.

Minutes of a Committee Meeting held at Adastral House, War Office, on July 17, 1918.

Present:

Lieut.-Gen. T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., K.H.S., Director-General, in the Chair.
Major-Gen. Sir W. Donovan, K.C.B.
Surg.-Gen. Sir D. Bruce, K.C.B.
Surg.-Gen. Sir H. R. Whitehead, K.C.B.
Major-Gen. Sir M. W. Russell, K.C.M.G.
Col. A. Peterkin, C.B.
Lieut.-Col. A. B. Cottell.
Capt. J. T. Clapham.

(1) The minutes of the previous meeting, held on April 17, were read and confirmed.

(2) Sir M. W. Russell and Sir H. R. Whitehead took their places on the Committee as Vice-President and member respectively.

(3) The Secretary reported that 102 fresh subscribers had been obtained up to date as a result of the special appeal for additional members. He also reported the present cash balance at the bank.

(4) A special appeal was considered from Mrs. L. M. T. for a grant towards the outfit expenses of her daughter who has just been elected to the Royal School at Bath, and it was decided to sanction £20 under Rule 24.

(5) The desirability of making it more widely known that the Funds of the Society are only available for the benefit of "orphans" was discussed, and the Secretary was instructed to draw attention to the fact in all notices issued from his office.

LIST OF GRANTS AUTHORIZED TO APPLICANTS AT THE ANNUAL GENERAL MEETING, JUNE 10, 1918.

Three orphans of T. McC.	£40	Orphan of J. O.	£30
Three orphans of G. C.	40	Three orphans of W. T. H.	30
Orphan son of P. O. I.	10	Orphan son of R. G. H.	20
Orphan daughter of I. McC.	20	Two orphans of R. D. O'C.	20
Two orphan daughters of V. H. S.	20	Orphan of W. F. T. I.	40
Four orphan daughters of W. S. H.	40	Orphan of H. P. E.	10
Orphan daughter of T. S.	10	Orphan of T. B.	40
Orphan daughter of I. C.	25	Orphan of A. T.	30
Two orphans of F. M. M.	20	Two orphans of C. J. H.	20
Orphan of R. A. C.	40	Orphan of E. W. B.	30
Seven orphans of J. W.	30	Orphan of B. C. S.	20
Orphan son of C. A.	30	Seven orphans of W. H.	40
Orphan of J. F.	30	Orphan of H. H. S.	25
Orphan of A. S.	20		£730

STATEMENT OF ACCOUNTS OF THE ROYAL ARMY MEDICAL CORPS BENEVOLENT SOCIETY FOR THE YEAR 1917.

Receipts.	£	s.	d.
To Balance at Bankers', January 1, 1917	451	4	6
,, Subscriptions	184	18	6
,, Donations—			
Officers' Mess, R.A.M.C., Training Centre, Ripon £20 0 0			
Col. and Mrs. Brunskill 5 0 0			
Officers' Mess, Rawal Pindi, per Capt. J. T. Clapham 16 17 9			
Surg.-Gen. O. R. A. and Mrs. Julian 30 0 0			
An Anonymous Friend, per Major T. H. Gibbon 14 0 0			
	85	17	9
,, Dividends—			
North Eastern Railway 3 % Debenture Stock (*less* tax £49 19s. 10d.)	149	19	8
London and North Western Railway 3 % Debenture Stock (*less* tax £50)	150	0	2
Midland Railway 2½ % Debenture Stock (*less* tax £40)	120	0	0
Caledonian Railway 4 % Debenture Stock (*less* tax £27 16s.)	83	8	0
Consols (*less* tax £8 5s. 8d.)	24	18	0
War Loan 5 %	19	5	1
,, Legacy from the late Sir C. Cuffe	10	0	0
	£1,279	11	8

Expenditure.	£	s.	d.
By Grants	755	0	0
,, Purchase of £200 War Loan 5 %	190	0	0
,, ,, £39 9s. 6d. War Loan 5 %	37	10	1
,, Bankers' Charges and Cheque Book	0	5	0
	£982	15	1
,, Balance at Bankers	296	16	7
	£1,279	11	8

Present price of following Securities—

£6,667 London and North Western Railway 3 % Debenture Stock, price about 60, value	£4,000	4	0
£6,666 North Eastern Railway 3% Debenture Stock, price about 59, value	3,932	18	10
£6,400 Midland Railway 3½ % Debenture Stock, price about 50, value	3,200	0	0
£2,780 Caledonian Railway 4 % Debenture Stock, price about 73 ex. d., value	2,029	8	0

Investments.	£	s.	d.
London & North Western Railway 3 % Debenture Stock	6,667	0	0
North Eastern Railway 3 % Debenture Stock	6,666	0	0
Midland Railway 2½ % Debenture Stock	6,400	0	0
Caledonian Railway 4 % Debenture Stock	2,780	0	0
Consols	1,327	7	9
War Loan 5 % £450	427	10	1
	£24,267	17	10

We have compared the above statement with the books and vouchers relating thereto, and certify it to be correct. We have verified the Bank Balance and the Investments.

Portland House,
Basinghall Street, E.C.,
April 30, 1918.

(*Signed*) EVANS, PEIRSON & CO.,
Chartered Accountants.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

SUMMARY OF THE PROCEEDINGS OF THE ONE HUNDRED AND THIRD ANNUAL GENERAL MEETING, WHICH WAS HELD AT THE ROYAL ARMY MEDICAL COLLEGE ON MAY 13, 1918.

Present:

Deputy Surg.-Gen. W. G. Don, Vice-President, in the Chair.
Surg.-Gen. Sir H. R. Whitehead, K.C.B.
Surg.-Gen. Sir M. W. Russell, K.C.M.G., C.B.
Major-Gen. J. J. Gerrard, C.B.
Col. W. T. Martin.
Col. Sir W. B. Leishman, K.C.M.G., C.B., F.R.S., K.H.P.
Lieut.-Col. J. Stevenson (a Trustee).
Lieut.-Col J. More Reid.
Lieut.-Col. G. S. Mansfield.

Letters regretting their inability to attend were read from Surg.-Gen. W. S. M. Price, and from Lieut.-Col. P. S. O'Reilly.

(1) The Minutes of the previous Annual General Meeting were read and confirmed.

(2) The Accounts and Report for the year 1917 were examined and adopted unanimously.

(3) Messrs. Deloitte and Co. were re-appointed Auditors for the current year.

(4) The election by the Committee, under Rule XXVI, of Surg.-Gen. Sir H. R. Whitehead, K.C.B., as a member thereof in place of Lieut.-Col. R. J. L. Fayle, D.S.O., resigned, was confirmed.

Major-Gen J. J. Gerrard, C.B., was elected a member of the Committee for the coming three years in the place of Col. Sir W. H. Horrocks, K.C.M.G., C.B., who retires at the expiration of his period of office.

The Meeting expressed much regret at the death of the late Mr. H. W. Andras, F.I.A., Consulting Actuary to the Society. (A resolution of condolence had been already sent by the Committee to his widow.)

Sir Michael Russell advocated the reduction, or abolition, of the present extra War charge. Under the Rules the Committe must be guided in this matter by the advice of the Actuary.

NOTICE.

This Fund provides annuities of £50 a year during widowhood, to the widow of the marriage, during which the subscription of a married member began. In the event of the death of the widow this annuity is continued to the children of such marriage until the youngest attain the age of 21 years. It also continues for their benefit, up to the same age, if the widow re-marries. Furthermore, should the wife of the subscriber predecease him, it will be optional for him to continue the subscription he had been paying as a married member, in order to provide an annuity similar to the above for the children of the marriage, until the youngest shall have attained the age of 21 years.

Provision is also made whereby a part of the surplus at any quinquennial valuation may be applied for the benefit of members, or their wives, or orphan children. Thus, by the appropriations of surplus at the valuations of December 31, 1910 and 1915, the prospective widows of first-class married members on the books at those dates, will receive, during this current quinquennium, £200 and £100 respectively at the death of their husbands, their annuities being also increased to the statutory limit of £52.

Examples of the rates of annual subscription are :—

Husband's age		Wife's age		Annual subscription
25	..	20	..	£13 8 5
30	..	27	..	£14 6 1
36	..	33	..	£16 17 2
46	..	40	..	£22 12 6
50	..	45	..	£24 9 5

The present extra War charge, which is subject to revision, is 25 guineas per annum, in addition to the normal annual subscription according to scale. Only Regular officers are eligible for membership.

Unmarried officers may become members by paying £2 yearly, and can thus reduce the rate of their subscriptions when married.

The Secretary will be glad to give any further information as to details.

J. T. CLAPHAM,
Captain,
Secretary.

3, *Homefield Road,*
Wimbledon, S.W. 19.
May, 1918.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

SUMMARY OF PROCEEDINGS OF A MEETING OF COMMITTEE HELD AT THE ROYAL ARMY MEDICAL COLLEGE ON APRIL 29, 1918.

Present:

Lieut.-Col. D. Harvey, C.M.G., representing London, in the Chair.
Major W. A. Ward, representing Aldershot.
Capt. H. S. Dickson, representing Woolwich.

(1) The Minutes of the Meeting of November 14, 1917, were read and confirmed.

(2) The Accounts and Report for the year 1917-18 were examined and adopted unanimously.

(3) A letter was considered from Mess President, Depot, Royal Army Medical Corps, Blackpool, stating that a Mess was to be opened in Blackpool, with a branch in camp at Squires Gate during the summer, and asking for a grant of £50 in aid of formation expenses.

(4) The question was considered of continuing the grant to the Aldershot Mess for maintenance purposes. Major Ward said the number of dining members had not increased since the original grant was made, a year ago, and that the funds available were quite inadequate for the maintenance of the Mess, apart from the help given by the Central Fund. The furniture, etc., of this Mess belongs to it and is not repairable by Government. The Committee considered that it was most desirable that the Mess property be kept in proper order and sanctioned a grant of £5 a month, payable by quarterly instalments in advance, for the year beginning April 1, 1918.

(5) The Hon. Secretary of the Aldershot Mess reported that, at present, there were sufficient means available for helping Mrs. Stacey, widow of the late Mess waiter, Mr. George Stacey.

(6) The Hon. Secretary of the London Mess stated that as regards the collection of heads which Lieut.-Col Sir J. S. Rogers had presented to that Mess there was no present opportunity of their being brought from Egypt.

(7) The Hon. Secretary having reported that there would probably be some surplus cash available for investment, it was resolved that the Chairman and Honorary Secretary be empowered to invest any available cash surplus, over and above the necessary balance at the bank, in either five per cent National War Bonds, five per cent National War Loan 1924/47 and in any new loan which may be issued, as may be considered most desirable by Messrs. Holt and Co. The Bonds to be held, as before, by Messrs. Holt and Co. on behalf of the Fund.

(8) Payment of the audit fee to Mr. E. T. Gann was sanctioned.

J. T. CLAPHAM,
Captain,
Hon. Secretary.

3, *Homefield Road,*
Wimbledon.

AUXILIARY ROYAL ARMY MEDICAL CORPS FUNDS.

THE usual Quarterly Meeting of the Committee was held at 11, Chandos Street, W. 1, on July 12. There were present: Major Maclean in the Chair, several members, including Major-Gen. T. H. Goodwin, Director-General Medical Services, the Hon. Treasurer and the Hon. Secretary.

From the Benevolent Branch for the relief of children of Officers of the Auxiliary Royal Army Medical Corps, who died as a result of the present war, grants were made in three cases. The amount granted was £176.

Grants from the Relief Branch for the relief of the widows and orphans of the Rank and File of the Auxiliary Royal Army Medical Corps were also made.

Subscriptions and applications for relief from either Branch should be made to the Hon. Secretary of the Auxiliary Royal Army Medical Corps Funds.

11, *Chandos Street,*
Cavendish Square, W. 1.

MEMORIAL TO LIEUT.-COL. H. MOORE, D.S.O., M.C., ROYAL ARMY MEDICAL CORPS.

A NUMBER of the friends and pupils of the late Lieut.-Col. Henry Moore, M.C., D.S.O., Royal Army Medical Corps, have decided to raise a Fund to perpetuate his memory by endowing a bed under his name in the Royal City of Dublin Hospital, where he spent the greater part of his professional life as student, house surgeon, and visiting surgeon. Would those willing to assist kindly communicate with Mr. G. Jameson Johnson at the hospital.

ROYAL ARMY MEDICAL CORPS COMFORTS AND PRISONERS' OF WAR FUND.

(Official Care Committee recognized by the War Office for the Royal Army Medical Corps.)

The following is a second list of contributions from companies and units at home and abroad to the Prisoners of War Fund received up to the end of April, 1918. It is hoped to publish further lists at an early date.

Information has recently been received that a large number of British Prisoners of War arrived at a certain camp all wounded, but the narrator adds that thanks to parcels from home, however, they were well fed and not forced like other prisoners to live on horse-chestnut soup and almost inedible bread.

This news, coming as it does from an independent source, gives us good hope that the parcels for all branches of the British Army, including the Royal Army Medical Corps, are regularly received , and this is borne out by the letters coming to the Ladies' Committee from the men themselves and from their relatives.

R.A.M.C. College,
Grosvenor Road, London, S.W. 1,
June 17, 1918.

E. M. Wilson,
Hon. Treasurer, R.A.M.C. Comforts and Prisoners of War Fund.

SECOND LIST.

List of Companies and Units, at Home and Abroad Contributions to Prisoners of War Fund in 1918.

April.	£	s.	d.
No. 6 Company R.A.M.C. and Detachments	75	11	9
R.A.M.C., Netley..	20	0	0
No. 2 Company, Aldershot ..	10	0	0
12 and 34 Companies, Woolwich	30	0	0
43rd Field Ambulance	40	0	0
111th Field Ambulance ..100 fr.	3	13	8
4th Cavalry Field Ambulance ..	4	0	0
4th Northern General Hospital, Lincoln	25	0	0
38th Field Ambulance	20	0	0
Rugeley Camp	5	0	0
1st and 2nd Training Brigades, Blackpool	8	18	10
1st Training Battalion, Blackpool	5	0	0
2nd Training Battalion, Blackpool	5	0	0
R.A.M.C. Detachment, Southampton Docks	10	0	0
20th Company, Tidworth ..	2	2	0
Sports Account, Blackpool ..	9	13	6
2/1st Wessex Field Ambulance..	10	10	0
1/4th South Lancashire Regt. ..	9	4	11
3rd Training Battalion, Blackpool	5	0	0
90th Field Ambulance	10	10	0
2/2nd West Riding Field Ambulance	10	0	0
134th Field Ambulance	5	0	0
26th Field Ambulance	4	4	0
P.O.W. Hospital, Lichfield ..	50	0	0
Regimental Institutes, Blackpool	300	0	0
10th General Hospital	39	8	11
1/3rd Highland Field Ambulance .. .. ..200 fr.	7	7	4
2/1st London Field Ambulance..	18	6	8
2/3rd Wessex Field Ambulance..	9	5	0
3rd Casualty Clearing Station ..	14	0	0
Malta Detachments	15	0	0
11th Stationary Hospital, France	5	0	0
42nd Field Ambulance	36	13	6
54th Field Ambulance	7	10	0
62nd Casualty Clearing Station..	5	0	0
14th Stationary Hospital	11	8	5
5th General Hospital	22	10	0
129th Field Ambulance	10	0	0
10th Field Ambulance	5	0	0
Military Hospital, Rugeley ..	9	0	0
51st Highland Division 800 fr. and	10	0	0
22nd General Hospital	69	4	6
No. 10 Stationary Hospital ..	50	0	0
50th Stationary Hospital ..	6	9	0
2/3rd East Lancashire Field Ambulance .. .. 1,000 fr.			
12th Casualty Clearing Station..	26	12	8
26th General Hospital	26	12	9
104th Field Ambulance (450 fr.)			
1st Southern General Hospital (T.F.)	60	0	0
101st Field Ambulance (100 fr.)	3	13	8
12th St. Louis, U.S.A. General Hospital	7	0	0
33rd Field Ambulance (580 fr.)..			
36th Casualty Clearing Station..	5	0	0
1/3rd East Lancashire Field Ambulance	12	3	0
64th Casualty Clearing Station..	16	16	5
25th Ambulance Train	5	5	0
52nd General Hospital	13	7	0
132nd Field Ambulance 700 fr. and	4	0	0
43rd Casualty Clearing Station (550 fr.)			
56th Casualty Clearing Station (500 fr.)			
Craig Lockhart Hospital, Officers	6	0	0
No. 4 Field Ambulance (300 fr.)			

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF APRIL, MAY AND JUNE, 1918.

Title of Work and Author	Edition	Date	How obtained
An Index of Differential Diagnosis of Main Symptoms. Edited by Herbert French, M.A., M.D.	3rd	1917	Library Grant.
Lectures on Massage and Electricity in the Treatment of Disease. By T. S. Dowse, M.D.		1906	,, ,,
An Index of Treatment. By Various Writers. Edited by Robert Hutchison, M.D., and James Sherren, F.R.C.S.	7th	1917	,, ,,
Physiological Abstracts. Edited by W. D. Halliburton. Vol. i., No. 1 to Vol. iii., No. 3.		1916-18	,, ,,
Anti-Malaria Work in Macedonia. By W. G. Willoughby and Louis Cassidy		1918	,, ,,
The Essentials of Chemical Physiology. By W. D. Halliburton, M.D., F.R.S.	9th	1916	,, ,,
American Addresses. By Sir Berkeley Moynihan, M.S., F.R.C.S.		1917	,, ,,
Handbook of Operative Surgery. By W. I. de C. Wheeler, B.A., M.D.	3rd	1918	,, ,,
Field Service Notes for Royal Army Medical Corps. By Colonel T. H. Goodwin, A.M.S.		1918	,, ,,
Surgical Therapeutics and Operative Technique. By E. Doyen. English Edition by H. Spencer Browne. Vol. ii.		1918	,, ,,
Analytical Chemistry. By Treadwell and Hall. Vol. i.		1916	,, ,,
How to Treat by Suggestion. By E. L. Ash, M.S. ..		1914	,, ,,
The Rhymes of a Red Cross Man. By R. W. Service ..		1918	,, ,,
Who's Who		1918	,, ,,
The New Hazell Annual and Almanack		1918	,, ,,
Malingering. By Sir John Collie	2nd	1917	Editor, Journal.
Malingering. By Jones and Llewellyn		1917	,, ,,
Hygiene and Public Health. By Parkes and Kenwood ..	6th	1917	,, ,,
Laboratory Studies in Tropical Medicine. By Daniels and Newham	4th	1918	,, ,,
Epidemics Resulting from War. By Dr. F. Prinzing ..		1916	,, ,,
The Drink Problem of To-Day. Edited by T. N. Kelynack		1916	,, ,,
Construction and Management of a General Hospital. By Donald Mackintosh		1916	,, ,,
On the Road to Kut. By Black Tab		1917	,, ,,
At Suvla Bay. By John Hargrave		1916	,, ,,
The Wounded French Soldier. By D. C. Calthrop ..		1916	,, ,,
Lord Lister. By Sir R. J. Godlee, Bt.		1917	,, ,,
Emergency Surgery. By John W. Sluss, A.M., M.D. ..	4th	1917	,, ,,
The Edinburgh Review, April		1918	,, ,,
Tropical Diseases. By Sir P. Manson, G.C.M.G... ..	6th	1917	,, ,,
Ambulance No. 10. By L. Buswell		1916	,, ,,
Minor Surgery and Bandaging. By M. Davies (Heath and Pollard)	16th	1917	,, ,,
The Practitioner's Pocket Pharmacology and Formulary. By L. Freyberger		1917	,, ,,
Memoranda on Army General Hospital Administration. By Various Authors. Edited by Lieut.-Col. P. Mitchell, M.D.		1917	,, ,,
The Causation of Sex in Man. By E. R. Dawson ..	2nd	1917	,, ,,
Library of Congress. Report for the Fiscal Year ending June 30, 1917		1917	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
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Military Overcrowding and the Meningococcus Carrier. By Capt. J. A. Glover, M.D., D.P.H., R.A.M.C. ..		1917	,, ,,
Memoranda Supplementary to Medical Research Committee, Special Report Series, No. 8		1918	The Editor.
No. 2. A Comparison of Patients with Valvular and Non-valvular Affections. By Thomas Lewis, M.D.		1918	War Office.
Journal of the Royal Naval Medical Service, April ..		1918	Royal Society.
Catalogue of the War Office Library. Part III (Subject Index). Sixth Annual Supplement (January to December. 1917). Compiled by F. J. Hudleston		1917	Presented by Surg.-Gen. Sir D. Bruce, K.C.B., F.R.S.
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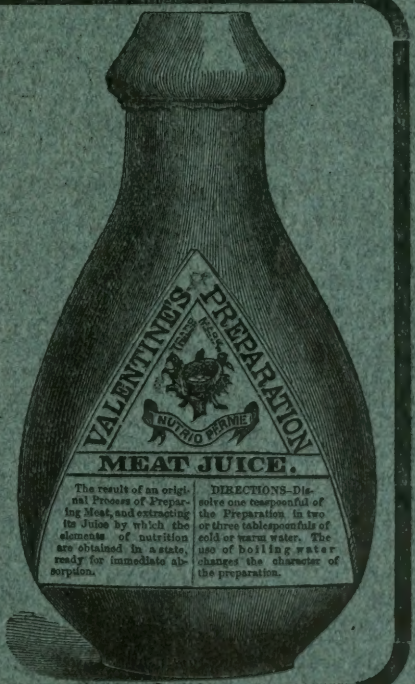
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